The Valuation Mirage

Chapter 2

Financial Modeling

Practical Development of Cash Flow Forecasts for Valuation

Chapter 2: Financial Modeling: *Practical Development of Cash Flow Forecasts*

Introduction

One of the inevitable steps in just about any valuation analysis is making some kind of explicit or implicit projection of cash flow and/or financial statistics. Making forecasts of the future could be accomplished by going to a fortune teller, but they are more often founded on a financial model (some argue that fortune tellers are more reliable). The objective of projections may be to derive forecasts of earnings per share, dividends and future capital gains on a stock; cash flows to equity and debt holders from investment in a project finance venture; or, cash flows and earnings that result from acquisition of an entire corporation or other statistics. A well-structured financial model should enable realistic and effective risk assessment (chapter 3) as well as the application of different valuation techniques (chapters 4, 5 and 6). To many people, mechanical issues addressed in this chapter that deal with how to structure, build and evaluate deterministic financial models (that is, models which do not incorporate probability distributions) are far more mundane topics than issues such as developing Monte Carlo simulation, valuing real options, estimating debt capacity and making forward price projections discussed in subsequent chapters. If your primarily interest is in these theoretical valuation issues or if you already consider yourself to be proficient in building models, this chapter could be skipped without affecting understanding of the subsequent topics. On the other hand, if you have not developed models or even if you are an experienced model-builder who would like see some novel modeling ideas, the techniques described in this chapter can hopefully make your life easier. Finally, if you have built some models and would like to see advanced issues related to project finance models involving cash flow waterfalls, funding cascades, debt sculpting, debt service reserve accounts and re-financing you may want to skip to the advanced issues at the end of the chapter.

One of the most influential and lasting ideas in finance has been the work of Modigliani and Miller in 1958 who suggested that the focus of valuation should be on free cash flow that can be distributed to debt, equity any other investors rather than the way the cash flow is split up between alternative investors (chapter 4). If you really still believe the theory developed by Modigliani and Miller that debt and other forms of financing does not make any difference in the way real world investments are made, you should then stop financial models after computing EBITDA, capital expenditures, working capital changes and taxes on operating earnings (EBIT). EBITDA, capital expenditures and working capital changes are the components of the typical definition of free cash flow. There is no need to compute earnings per share, equity cash flow, debt service coverage or a balance sheet. Operating cash flow less taxes that must be paid before money goes to investors. Capital expenditures that must be made to sustain operations and working capital changes adjust EBITDA to reflect true cash flow. Although calculating prices, demand, cost structure and the cost of capital equipment – the drivers of free cash flow -- is the most important aspect of any model, almost all of the valuation techniques described later in the book require analysis of items in addition to free cash flow. When financing is explicitly considered, models may concentrate on earnings after interest and/or debt and equity cash flows after debt service and/or financial ratios that include balance sheet items. Therefore, much of the discussion of financial models in this chapter considers the financial structure of the company and the distribution of free cash flow to debt investors, equity investors and income taxes.

Probably the only real way to learn financial modeling is working late at night with a tight deadline under the pressure of a transaction. Real modeling is not a linear process, but involves gathering information, focusing on data that is relevant and coming up with ways to best represent the business. The process of developing revenue from volume sold and capacity is generally the most time consuming and important part of the model that requires a lot of time and creative thinking. Notwithstanding this, outlining the structure of models and presenting real world examples in this chapter is intended to provide a head start

for those who have not build models and will have to learn the hard way. Further, some of the concepts presented below can be helpful even to experienced model builders in designing and structuring more efficient, stable, transparent and accurate models. The chapter provides practical instructions on how to build a well structured financial model that clearly delineates inputs, effectively presents key value drivers, uses separate modules to organize various components in a logical manner, accurately computes cash flow that is available to different debt and equity investors, and presents results of the analysis that effectively represents risks of the investment. Unlike other chapters where statistical, economic and financial theory provides the basis for making forecasts and assessing risk, the modeling issues discussed here can generally be explained using a cook-book style step by step approach. A bit of theoretical discussion of how different types of models can be used to establish value is included, but the main objective of this chapter is simply to provide details on how to build better models. In discussing the process for building an efficient financial model, this chapter is organized into the following sections which correspond to general structure of a financial model:

- Model objectives and the general notion of keeping models simple
- Structure and layout of alternative types of models
- Avoiding bad spreadsheet programming practices
- Organizing time periods in a model
- Projecting revenues, expenses and capital expenditures in a working analysis
- Programming the debt schedule with alternative loan structures
- Developing fixed asset modules with depreciation and amortization
- Creating the income statement and tax schedule
- Establishing the cash flow statement and a cash flow waterfall
- Generating a balance sheet and other auditing tools
- Presenting key valuation outputs of a model
- Computing the value of investments from cash flow forecasts in alternative models

In addition to these subjects, the chapter includes appendices that address specialized topics. The first appendix describes how to model real estate investments with a portfolio of different of types of projects. The second appendix addresses modeling issues that arise in valuing financial institutions.

Some of the subjects discussed in this chapter such as organizing time periods of the model, using techniques to verify the accuracy of mechanical calculations and computing tax depreciation are not very glamorous. While these topics may not have dramatic effects on valuation, use of good modeling practice can improve the efficiency of the process and allow you to spend more time on the important issue of risk analysis (chapter 3). Moreover, there are many practitioners who have created models the wrong way for a long time who can attest that a few simple ideas regarding structuring and programming models can dramatically improve the operation of a model and ultimately improve valuation analysis.

In addition to describing the idea behind various modeling concepts, each section of this chapter includes a few practical programming tips that that can make financial models more efficient. Further, a set of model building exercises are included on the DVD and the website that address each modeling issue if you would like to practice. The exercises are designed so that you can work through each of the modeling techniques and be able to master the programming approaches when applying them to any financial model. Finally, complete template models are also included on the DVD so that you can see what a completed model may look line and steal some modeling ideas.

After the financial crisis of 2008 that was caused in part by aggressive and often fraudulent sub-prime lending practices along with the associated structured finance products such as collateralized debt obligations, some have suggested that complicated investments are simply too difficult and opaque for investors to understand and value. Investment bankers had supposedly created dangerous overly-complex products that could not be analyzed. To model the value of these structured investments (so named because they split-up or structure operating cash flows to different investors) financial models had to be created that not only measure operating cash flow, but also who gets the cash flow in what order in alternative states of the world. Modeling of CDO's is famous for being "confusedly elegant" and relying

on complex statistics that are all but impossible to interpret. The outputs of fancy statistical analysis was sold as really representing economic behavior and sophisticated models that measured value at risk and the probability of default gave people a false sense of comfort that they could take risks which in hindsight turned out to be silly. By working through the financial modeling mechanics in this chapter, you should see that valuation errors made because models or studies are incomprehensible are no excuse for poor risk assessment. Building a financial analysis were one sees which investor receives cash flow in what order and then performs risk analysis even for a toxic collateralized debt obligation is not difficult if you are careful with the structure of the model. Finally, even if you are an "excel phoebe" you should be able to understand financial models and make informed decisions about the risk of a security. Financial modeling is not very complex or mysterious even though financial modelers sometimes seem to be involved in a conspiracy that makes the analysis impossible to understand.

Model Objectives, Model Types and Keeping Models Simple

As emphasized in the case studies of valuation mistakes from the first chapter, effective risk assessment is the centerpiece of valuation. Depending on the valuation approach, risk assessments address risks to equity holders, risks to senior debt providers or risks to other parties such as contract counterparties. One of the two central ideas in building a model of future cash flows is to assess risks in a transaction, whether the transaction is simply purchasing a stock, borrowing money, investing in an airport, acquiring a company or signing a contract. Assessing risks can mean evaluating to what extent a particular covenant reduces risk of default to determining how demand growth affects cash flow. The second general objective of building a financial model is to structure a transaction. This may mean sculpting debt repayments in a project financing transaction, sizing the senior debt in a leveraged buyout or developing the share exchange ratios in a merger.

Some rather complicated modeling techniques are presented in this chapter, but the most important modeling ideas involve relatively simple programming techniques. Despite working through a few somewhat complex modelling issues such as cash flow waterfalls, accelerated depreciation, debt defaults, tax loss carryforwards and resolving circularity associated with capitalized interest and sculpting debt, models should generally be kept as simple as possible. According to an organization that thinks about modeling issues: "financial models must be as simple as possible, but no simpler."[1] Instead of worrying obsessively about small details in a model, it is generally better to concentrate on assuring that risks of key variables are effectively presented alongside the value statistics. After the financial crisis, there has arguably been a movement back to fundamentals and creation of simple models which assure that the most important variables do not get lost in overly complex models and transactions. For example according to an article in the Financial Times, Moody's complex financial models for evaluating a certain type of CDP, a CPDO, contained a bug had a big impact on ratings[2]:

> *A single small error in the computer coding that Moody's used to run its CPDO performance simulation had thrown the results way off. When the error was corrected, the likelihood of CPDO default increased significantly. CPDOs, it turned out, weren't triple-A products at all. Preliminary results suggested the error could have increased the rating by as many as four notches.*

Instead of creating models that are overly complex, when one is evaluating the risk of subordinated debt in a structured finance transaction, a simple but effective way to present risk is to see how low or high a variable can move before defaults occur – the break-even point (chapter 3). Once the break-even point is known, then the focus of the analysis can be on the possibility that the variable can reach such a pessimistic level. Much more complex modelling with Monte Carlo simulation with sophisticated analysis of probability distributions may not be nearly as useful in evaluating the

[1] Caroline von Schmalensee, FAST Modelling Standards, Coordinator: Version: FAST01a: 03 March 2010 http://www.FASTstandard.org/
[2] FT: When junk was gold (rating agencies and sub-prime), By Sam Jones. Illustrations by Balint Zsako, Financial Times, Published: October 17 2008.

investment decision as this simple break even analysis. Models should not become impossible to understand large black-boxes with thirty different spreadsheets as illustrated by the quote below.[3]

> *Our experience in the financial arena has taught us to be very humble in applying mathematics to markets, and to be extremely wary of ambitious theories, which are in the end trying to model human behavior. We like simplicity, but we like to remember that it is our models that are simple, not the world.*

In order to manage the discussion of different financial modeling issues, financial models are broadly categorized into three different types for purposes of the discussion – deterministic models, stochastic models and back of the envelop models. Deterministic and stochastic models receive the most attention in discussion of valuation, but the third type, the back of envelope models should be part of the process:

Deterministic Models: Deterministic models are the kind of models most of us are familiar with. Even with all of the methods presented below to make the models transparent and logically structured, these deterministic models can become large and difficult to audit. Risk analysis in deterministic models is generally computed using judgmental assessments about how selected variables can change relative to base case assumptions. For example in valuing a hotel, one would develop projections of the room price per night, the occupancy rate, operating expenses and so forth to compute projected cash flow and value.

Stochastic Models: Stochastic models build on deterministic models but include probability distributions around key variables. The probability distributions depend on relatively sophisticated mathematical analysis of economic variables and their correlation with one another. (Chapter 3) After the stochastic variables are added to a financial model, one can compute probability distributions associated with key valuation measures such as rate of return or probability of default. For example in analyzing a hotel, one could assess the probability distribution of future occupancy rates and convert those to a distribution of rates of return.

Back of the Envelope: Simple back of the envelope models can be more important than the other two model types. These models may involve developing some kind of metric to check whether the complex model results are reasonable or they may involve simple statistical checks of the valuation. For example, in valuing a hotel one could calculate the value per room and assure it is reasonable relative to the costs of other similar hotels. Alternatively you may compute the return on investment on a year by year basis and think about whether it is really possible to earn the returns given the competitive structure of the industry. Coming up with effective ways to independently check a model can require more creativity and be more difficult than the other models.

The description of modeling methods in this chapter and the next address the first two model types: deterministic models and stochastic models without discussing the third type. This does not mean that back of the envelope models should be considered less essential in the valuation process. In fact, developing simple models (which is not synonymous with easy models) may be more important than any of the other analyses. Proving a valuation concept with a relatively simple analysis should if possible be the beginning of the analysis as well as the end of the analysis. One actual example with not making a back of the envelop analysis is demonstrated by a case where various different companies were asked to bid for the purchase of exiting electricity plants. The electricity plants were sold by a company named Central Main Power Company ("CMP") and the company that "won" the bid was named FPL Energy for $886 million. The plants being sold were old and consisted of 1,185 MW; the largest plant in the portfolio

[3] Emanuel Derman Paul Wilmott, January 7 2009 "The Financial Modelers' Manifesto"

was an oil fired plant in the U.S. State of Maine named the Wyman plant (594 MW) which had entered service about twenty years earlier.

When selling the plants, CMP used an auction process which of course came along with a strict deadline for submitting bids. FPL was able to buy the Wyman Plant and others by making a bid that was higher than the bids submitted by other companies and it is safe to say the FPL experienced a case of buyers curse. FPL most probably used very sophisticated projections of future electricity prices, transmission constraints, and natural gas prices along with a big deterministic financial model in coming up with its bid. As is common in this sort of analysis, the modeling was likely finalized late at night and everyone was probably very tired. In the end, the FPL bid for the old oil plant and the other used plants of $748/kW was a lot more than the cost of new and much more efficient natural gas combined cycle plants which were being constructed at a cost of less than $600/kW.[4] According to rumor, FPL's sophisticated models contained errors that resulted in the high valuation. A back of the envelope analysis would have developed an approximate valuation by discounting the cost of a new plant to consider age and efficiency factors. Little more than a year after the purchase, FPL took a $176 million write-off as a result of paying too much for the CMP assets.[5] In this situation, a much simpler model that adjusted the cost of a new plant for the age and other factors would have been an important check of the sophisticated deterministic or stochastic models.

Model Layout for Alternative Types of Valuation Analysis

Before beginning to enter data writing any excel formulas or making valuations, you should think about the architecture of a model. The structure of an analysis involves organizing the inputs, constructing mathematical calculations and presenting outputs. When thinking about the general design of a financial model, one should decide how to organize the inputs from various information sources in an organized way; how to formulate the mechanical calculations in a transparent manner that is easy to audit; and, finally how to present the outputs so that purposes of risk assessment and valuation. Other than structuring the inputs, calculations and outputs of a model, subjects that should be considered in laying out the model are the programming of time periods, the methods for verifying model accuracy and the setting-up of alternative scenarios. Much of the process in developing an effective model is simply putting things in an order that makes sense and understanding the starting point of the model.

The layout and ordering of items in a financial model to a large extent depends on the type of investment being assessed. Most financial models can be classified into four general categories -- corporate models, project finance models, acquisition models and merger integration models. Because of different data sources and alternative valuation techniques, the layout of financial models is different for each of these model types. In addition to the four general models, specialized models can be constructed for real estate development projects as well as for banks and other financial institutions.

Various model types have different objectives and a different structure. The valuation techniques, data sources and outputs of these models can be summarized as follows:

Corporate Model: The distinguishing feature of the first and most common model type, a corporate model, is that a corporation has a history and it is assumed to last indefinitely (although virtually all companies will either end up in bankruptcy or eventually be purchased.) This means that valuation of a corporation begins with historic analysis and the models must include some kind of terminal value assumption. The terminal value calculation is necessary because it is not reasonable to make detailed forecasts of cash flow item for the indefinite life of the corporation which would require forecasts for fifteen to fifty years into the future. An important item

[4] 2001 FPL SEC 10-K.

[5] 2001 FPL SEC 10-K, the official reason given by FPL for the write-off was a change in regulations regarding transmission pricing.

in corporate models is the projection of earnings per share since this is the number evaluated by investment analysts.

Project Finance Model: The second type of model, a project finance model, differs from a standard corporate model because the investment is characterized by different phases with different risks; the fact that no history on cash flows exists for the investment (no matter how many times a similar new combined cycle plant is built, you don't know how it will work until you switch it on); and the isolation and quantification of particular risks. Rather than spending time on studying history, consulting studies and consulting reports such as traffic studies, price forecasts and marketing analyses. The project finance models focus on cash flows accruing equity holders and lenders rather than earnings and the projections generally cover the entire defined lifetime of the project.

Acquisition Model: The third type of model, an acquisition or leveraged buyout model, measures the returns earned from an acquisition transaction which is characterized by the consideration paid for the equity of the company, the holding period of the investment and exit price as well as the manner in which the acquisition is financed. To compute equity returns, acquisition models measure the manner in which alternative financing sources are repaid and ultimately compute the return earned by equity investors.

Merger Model: An integrated consolidation model computes earnings per share and credit quality measures on a standalone and a consolidated basis before and after a merger or acquisition. This type of model considers the specific financing and accounting of the transaction as well as cost savings or synergies generated by the transaction. A common application of this type of model is to evaluate how much can be paid for a company before earnings dilution will occur and bond ratings can be maintained.

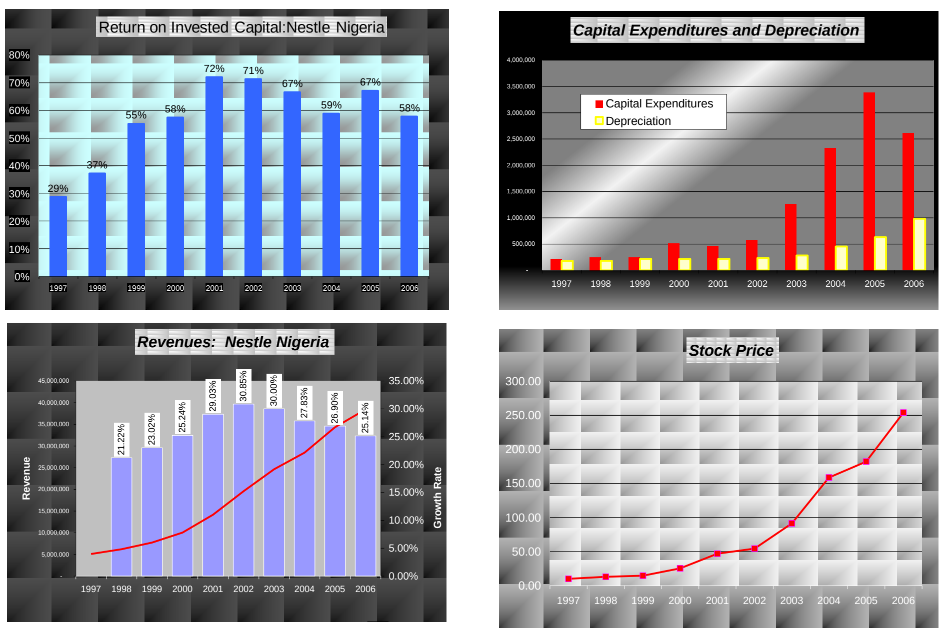
Real Estate Model: A real estate model is a cousin of project finance models except that a group of multiple investments in a portfolio are combined together. For example, a mixed development model includes different residential properties with different construction start and finish dates as well as different commercial and even industrial properties. Real estate models must be able to evaluate cash flows that are produced at different time periods without a single construction and operation period. Further the models must be able to quantify the effects of different holding period strategies and alternative tax treatments. Appendix 1 discusses the real estate models in more detail.

Each of the different model types has a lot in common. They each require up front thought as to the structure and the scope of the model; they each require analysis of timing issues; they each should be segregated into components and begin with layout of operating and financing assumptions; they each should each have verification analyses; they each should have a starting point; they each should not contain bad programming practices; and they each should be structured so as to facilitate effective risk analysis. However, each model structure contains unique complexities that can make the models un-transparent, in-flexible, in-accurate and un-stable. Differences between the structures of alternative model types are discussed below.

Structure of a Corporate Model

Corporate models are used to compute free cash flow for making valuations using a DCF analysis, for estimating earnings per share, for making credit analyses or for forecasting other financial ratios. Because a corporation has historic financial statements, the first step in creating a corporate model

should be evaluating historic data so as to develop assumptions and to understand the financial structure and performance of a company. As part of the historic evaluation, the models can use financial ratios such as return on invested capital, EBITDA margin and credit ratios to tell a story about what has happened to the company. Analysis of financial ratios provides a basis for comparing projections with actual results and it is the most fundamental difference between corporate finance and project finance. In project finance one needs some kind of consulting study or contract because historic trends from financial statements are not available. In corporate finance the modeler should be part historian and part statistician in evaluating historic financial ratios. Different ratios may be appropriate to paint a picture of different companies: sometimes it may be trends in return on investment; in other situations it may be the ratio of capital expenditures to depreciation; in yet others it may be the interest coverage ratio. A big problem for investors in the case of Constellation Energy discussed in chapter 1 was that there was no way to really dissect the financials of the company and compute effective metrics that told a story about how the company was taking excessive risks in order to grow. The example below shows how graphs of historic data in a historic model can provide insight as to where value comes from. The company, Nestle of Nigeria, earned returns that were above the cost of capital (the easiest way to compare the return on investment with the cost of capital is to compare returns to the interest rate rather than trying to make sophisticated calculations of weighted average cost of capital.) At the same time, revenues were growing and the capital expenditures were greater than depreciation. This resulted in large increases in the stock price shown in the final panel of the figure.

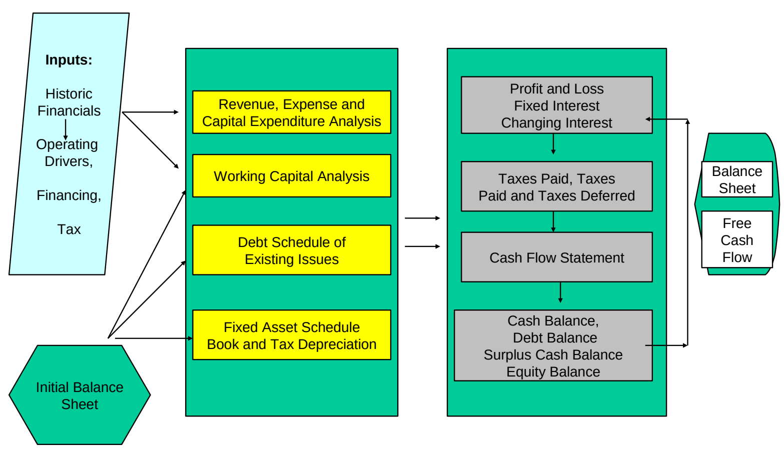


After painting a picture with historic financial statement analysis, structuring a corporate model includes defining how one incorporates history, uses an opening base year balance sheet and connects interest expense and interest income in the income statement to the balance sheet debt through evaluating the cash flow. The process of beginning with a historic balance sheet and then working through each component of the balance sheet in distinct parts of the model produces a structure which should be transparent and mechanically accurate. In a corporate model, two very simple ideas can dramatically improve the structure of the model. The first is simply realizing that all of the fixed asset accounts, debt accounts, working capital accounts, deferred tax accounts, accumulated depreciation accounts, surplus cash accounts, and other items come straight from the initial balance sheet. The second is setting up accounts for all of these items where the initial closing balance comes from the balance sheet. For example, the closing balance for the fixed asset account should come straight from the balance sheet. In the subsequent periods, the opening balance is the same as the prior period closing balance. Capital expenditures are added to the opening balance (and retirements can be deducted from the balance) to

yield the closing balance for the next period. Once the closing balance is established, the same process is repeated for the remaining periods of the model.

The diagram below is intended to illustrate some of the important points about structuring a corporate model. The process begins with analysis of history and the initial balance sheet. The working analysis, the fixed asset balance and the debt schedule shown in the middle column are the essential intermediate steps that should be completed before constructing financial statements. Developing revenues, operating expenses and capital expenditures in the working sheets is just about always the most important part of the analysis. It is generally a good idea to graph history and projections of key variables that drive these three things such as prices, market share, industry demand growth, capacity utilization, variable costs and capital expenditures per unit. Once these preliminary parts of the model are complete, financial statements can be constructed. As most of the components of financial statements have already been computed, this part of the analysis, shown in the third column of the diagram, should be quite simple. One of the main computational challenge in a corporate model is to determine how surplus or deficit cash should be deployed and to develop projections of depreciation and deferred taxes that account for the lifetime of different asset classes. The diagram illustrates that connection of the profit and loss statement with the interest expense and interest income that is a typical characteristic of a corporate model (which can create circularity). The arrow on the right of the diagram is meant to show that interest expense on new debt calculated from the model is not known until the debt balance is computed from the cash flow and interest income on surplus cash is not known until the amount of surplus cash is derived. Unlike project finance models, dividends are determined from an algorithm such as a payout ratio and are not the result of the cash flow process.

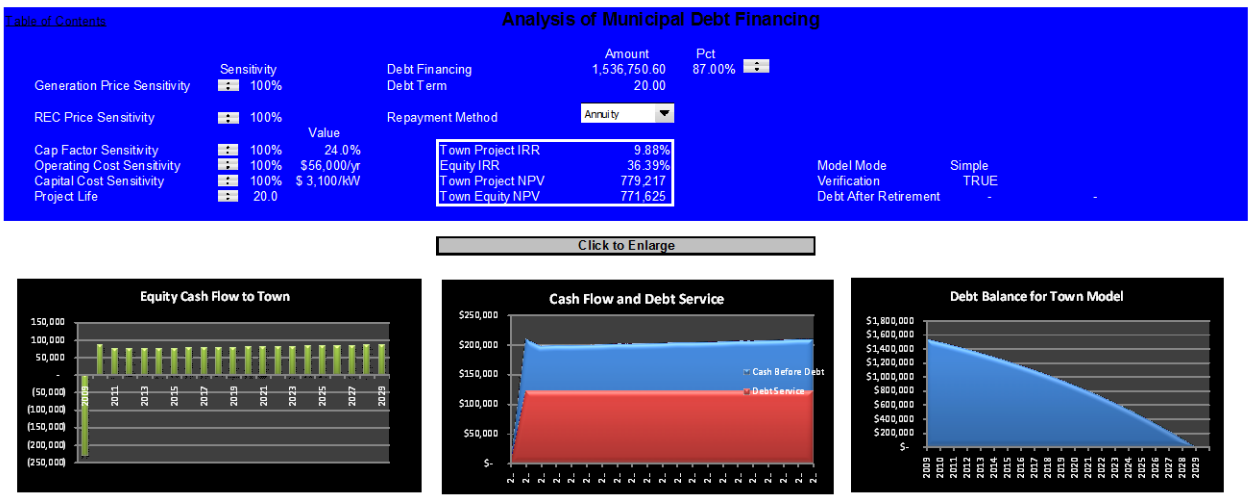
Structure of a Standard Corporate Model



The final column of the diagram on the right shows that the balance sheet is an output rather than part of the mechanical calculations. To make the balance sheet, the common equity balance can be calculated as are the other balance sheet accounts. In a similar way to the other accounts calculation of common equity begins from the opening balance of the equity (in the first year from the initial balance sheet). To compute the closing balance, the net income and equity issuances are added and the dividends and equity buybacks are subtracted. A similar account can be computed for minority interest. With all of the accounts completed including the equity balance, the balance sheet can be computed by simply gathering together the closing balance of all of the accounts. Much of the remainder of this chapter is structured to work through each part of the model shown in the diagram above: there is a separate section discussing the input section; the working section; the debt schedule; the profit and loss statement and so forth.

Structure of a Project Finance Model

A project finance model contrasts with corporate models that are founded from historic data. Key outputs from the project finance model are related to cash flow: the growth rate of equity cash flows which is called the equity IRR (discussed in detail below); and, the ability of cash flows to cover debt service in each period which is called the debt service coverage ratio (chapter 4). Project finance models are typically used for two distinct objectives. The first is to structure the debt and equity that will be issued in the transaction including the size of the debt, the tenor of the debt and the manner in which debt will be repaid. The second is to assess specific risks of the project given the defined financial structure. Unlike corporate models, the information base for project finance models is a series of contracts, construction budgets, engineering data and possibly projected commodity prices. Given that there is no historical record for a project finance corporation called a special purpose vehicle (SPV) and therefore no historic balance sheet, the launching point for projection of financial statements is a sources and uses of funds during the construction period rather than the balance sheet. An example of outputs from a project finance model is shown in the diagram below. Key drivers of the project such as the capital cost per unit of output, the product price and the utilization are shown together with the IRR and various different ways to measure the debt service coverage.

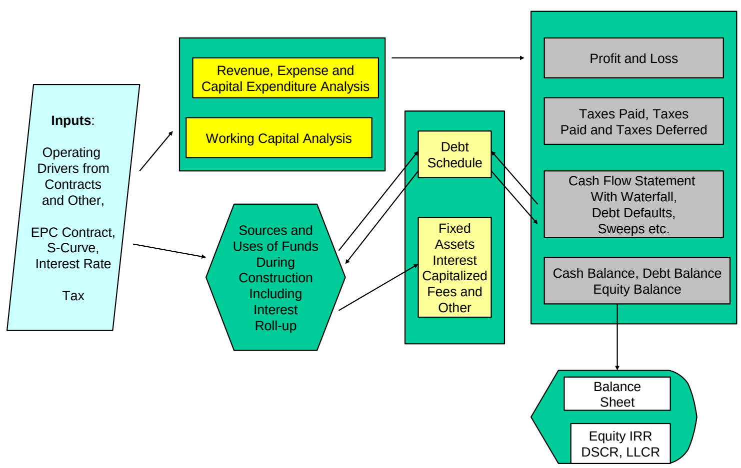


The structure of a project finance model is illustrated on the diagram below. One of the essential elements of a project finance model is that different calculations are made for distinct phases of the project – the development phase, the construction phase and the operation phase and the debt repayment phase. The sources and uses statement is computed during the development and the construction phase. While the things that go into this part of the model are not complicated to think about – what ones spends money on and how one raises the money – the source and use statement provides a good picture of what the project is about (recall Eurotunnel from Chapter 1). From a mechanical perspective, the sources and uses statement replaces the balance sheet as the starting point for the balance sheet accounts such as the fixed assets, the debt balance, the debt service reserve balance and so forth. This is illustrated in the diagram where arrows from the source and use statement launch the fixed asset schedule and the debt schedule. The working module that computes revenues and expenses is similar to the corporate model as is the fixed asset schedule and the debt schedule. Part of the debt schedule is computing the interest during construction that is capitalized to the cost of the plant.

A project finance model can involve complex programming issues regarding (1) setting-up time periods; (2) working out a funding cascade for senior debt, subordinated debt, and equity; (3) modeling the debt service reserve account and the maintenance reserve account; (4) developing a cash flow waterfall that works through cash flow priorities; (5) sculpting debt repayments to meet a debt service coverage constraint, and; (6) re-financing debt and incorporating cash sweep covenants. The difficult challenge in creating a project finance model is to address these issues without making the model hopelessly complex and cumbersome with many macros and complicated formulas. A separate section at the end of the chapter addresses programming issues to resolve these issues in a painless manner as possible.

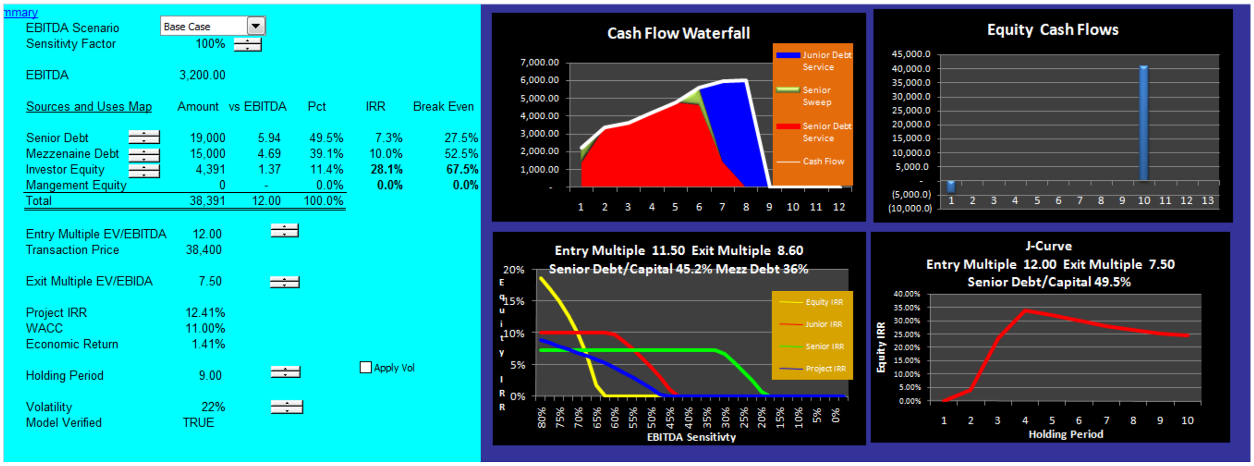
Since a project is generally a one-off investment where debt and equity investors focus on cash flow rather than accounting earnings, the structure for computing cash flow is also different in a project finance model then in a standard corporate model. For a project finance model, the final part of the cash flow waterfall is the dividends paid to the owners of the SPV (sponsors) meaning that dividends are not defined by a dividend payout, dividend per share or some other algorithm, but rather are the residual cash flow not paid or reserved elsewhere. As illustrated in the diagram below, effective modeling of cash flows involves integration of the debt schedule with the cash flow waterfall in the cash flow analysis as well as launching the model from a sources and uses of funds analysis. Risk analysis of a project finance model is also different phases as the construction period typically involves technical risks and the operation period includes economic risks. Finally, as with the corporate model, the balance sheet is part of the output in which all of the accounts such as plant balance, debt service reserves, senior debt balance, subordinated debt balance and common equity balance are already defined. If you want to get your hands dirty and work through the structure of a project finance model, complete the first exercise in the project finance model folder.

Structure of a Project Finance Model



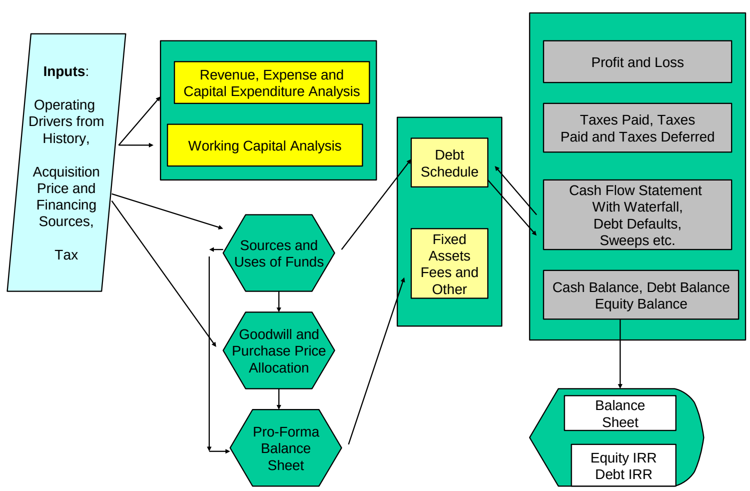
Structure of an Acquisition Model

An acquisition model is typically developed to determine how much to pay for a target company and how much of the purchase price can be financed with different types of debt including amortizing debt, debt with a bullet maturity and debt with capitalizing interest (this is sometime known as "ABC.") Key assumptions in an acquisition model include how much the operating cash flow can grow with new owners and a new strategy as well as the how much the company can be sold for after the holding period. Financial ratios used in assessing an acquisition are often related to the EBITDA. These include the enterprise value (debt plus equity value) to the EBITDA; the senior debt level to the EBITDA; and the total debt level to the EBITDA. As with a project finance model, an acquisition model can be used for both structuring the amounts of different type of debt as well as risk assessment. The figure below illustrates output from an acquisition model that could include an illustration of how cash is distributed, break-even points and a J-Curve that illustrates optimal holding periods and equity cash flows that drive the equity IRR.



The structure of an acquisition model is illustrated in the diagram below. The diagram illustrates that modeling a leveraged acquisition transaction involves combining some aspects of corporate models and other aspects of project finance models. As with a corporate model, the history of the company should be studied when developing acquisition models. However, as with a project finance model, an acquisition model should begin with a sources and uses analysis that shows how much cash is used for the transaction and where the cash comes from. After the sources and uses map is established, a goodwill analysis should be added that allows construction of a pro-forma balance sheet. The general structure of computing a pro-forma balance sheet through mapping the sources and uses of funds along with a goodwill analysis that incorporates the accounting aspects of the transaction is shown in the second column of the diagram. Once the pro-forma balance sheet is created, the modeling process contains similarities to both a corporate model and a project finance model. As with a corporate model that works through different asset and liability accounts on the balance sheet, an acquisition model works through accounts where the first year closing balance comes from the pro-forma balance sheet. An acquisition model also has phases as does a project finance model – in particular, the transaction period should be distinguished from the holding period and the terminal period. In addition, an acquisition model also has phases as does a project finance model – the transaction period should be distinguished from the holding period and the terminal period. The right hand side of the diagram shows that the cash flow modeling process is analogous to the methods described for a project finance model where a waterfall progression measures the priority of cash flows to the various sources of funds and ultimately the equity holders.

Structure of an Acquisition Model

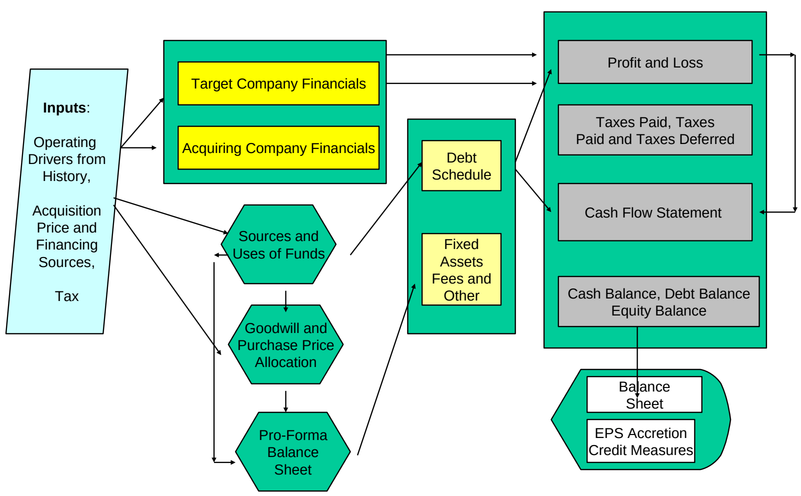


Structure of an Integrated Merger Model

The idea of a merger integration model is evaluate how much to pay for a company and how to structure the financing of a merger. To do this an integrated merger model can be developed that compares earnings per share with a merger and without a merger along with the credit quality of the combined company. The prospective earnings of the combined company depend on how much is paid for the acquisition and how many synergies are generated from changing management. When measuring the cost and benefits of a merger, the information base is the historic operations, projected cost savings and/or revenue increases and transaction terms. The valuation section below illustrates the output of an integrated merger model and explains how the valuation of a target company can be accomplished without worrying about the discount rate or the terminal value.

The diagram below of an integrated model demonstrates that this structure mixes elements of an acquisition model and a standard corporate model. As with the leveraged acquisition model, the starting point of a merger integration model is a sources and uses analysis of the transaction and the pro-forma balance sheet after goodwill and other adjustments. The only difference is that the pro-forma balance sheet begins with existing balance sheets of both the target company and the acquiring company. For an integration model, the transaction assumptions incorporated in the sources and uses analysis may include a share exchange, multiple debt issues and new equity offerings. Once the starting balance sheet established, the remaining calculations of the cash flow process are similar to the corporate model where computation of net cash flow leads to the accumulation of a net cash balance and the net cash balance is separated between short-term debt and surplus cash liquid investments. The debt schedule shown in the middle column of the diagram includes issues retired in the transaction (shown in the sources and uses analysis) and new issues to finance the merger as well as the associated fees and breakage costs. Shares issued in the transaction could come from offering new shares or from the shares issued to target company shareholders as part of a share exchange transaction. The diagram shows that instead of computing a working analysis to derive revenues, expenses and capital expenditures these numbers come from individual corporate models for the target company and the acquiring company. The most difficult item to project is the synergies that arise from management changes that occur with the transaction. In the real world, these synergy projections must be made with only public information and no time.

Structure of an Integrated Consolidation Model



A comparison of the elements that are included in the layout of different types of financial models is shown in the table below.

	Project Finance	**Corporate Model**	**LBO Model**	**M&A Integration Model**
Information Base	Contracts and analysis of Commodity Prices and other value drivers	Historical financial statements; Analysis of value drivers	Historical financial statements; Analysis of value drivers; Transaciton Terms	Historical financial statements; Analysis of value drivers; Transaciton Terms
Model Starting Point	Sources and Uses Analysis	Historic Balance Sheet	Sources and Uses and Pro-Forma Balance Sheet	Sources and Uses and Pro-Forma Balance Sheet
Cash Flow Process	Cash flow waterfall that ultimately measures dividends paid to equity	Net cash flow after dividends that result in changes in short-term debt or surplus cash	Cash flow waterfall that ends in dividends paid to equity	Cash flow changes that result in changes in short-term debt or surplus cash
Debt Analysis	New Debt Issues from Transaction	New and Existing	New Debt Issues from Transaction	Existing Debt Issues; Retired Debt Issues; New Debt Issues
Model Termination	End of project life	Arbitrary terminal period	Transaction holding period	EPS analysis period
Model Complexities	NOL; cash traps and sweeps; construction period issues; debt service reserves; debt sculpting	NOL; target capital structures; circularity; depreication vintage	NOL; cash sweeps; interest capitalization on sub debt; debt service reserves; terminal period	Pro-forma balance sheet; minority interest changes; new debt issues
Model Output	Equity IRR; Project IRR; DSCR	DCF Valuation; EPS projection; Implied P/E; Credit Quality	Equity and Debt IRRs; Debt/EBITDA	Project EPS and Other Ratios on Standalone vs Combined Basis

Subsequent sections of this chapter discuss issues in creating each of the major model components. In addition to the general description of what should be included in each section, a discussion of some practical programming tips for those who are involved in construction of models on a regular basis.

Building a basic model is relatively simple. This chapter delves into more complex issues that include the following for the various different models

Corporate models

- Flexible incorporation of historical financial data and updates
- Modelling projected deferred taxes and net operating losses
- Including target capital structures in the models rather than assuming net cash flow builds up cash balances or accumulates debt
- Development of effective assumptions that include industry supply and demand and conversion of capacity, demand and market share into revenues, expenses and capital expenditures
- Dealing with unfunded pensions, derivative assets and liabilities, stock options, intangible assets and other items.
- Use of models to predict credit quality
- Modelling asset retirements for new capital expenditures and exiting depreciation expense

Project Finance Models

- Timing and monthly models
- Cash flow waterfalls
- Debt repayment and sculpting of debt repayments

- Capitalized interest with sizing debt commitment and alternative draw-downs
- Debt service reserve balances and movements and their interaction with other factors
- Re-financing of debt

Acquisition and Leveraged Buyout Models

- Cash flow waterfall with alternative amortizing, bullet and capitalizing debt as well as cash requirements and revolving debt facilities
- Pro-forma balance sheet and structuring transaction
- Income taxes and alternative tax treatments of transactions
- Earn out provisions
- Value of equity kickers

Integrated Consolidated Models

- Pro-forma balance sheet and structuring transaction
- Deferred income taxes and alternative tax treatments of transactions
- Incorporation of new debt in transaction
- Evaluation of effects of goodwill and intangible amortization

Real-Estate Models

- Integrating Pro-forma balance sheet and structuring transaction
- Deferred income taxes and alternative tax treatments of transactions
- Incorporation of new debt in transaction
- Evaluation of effects of goodwill and intangible amortization

Avoiding Bad Programming Practices and Model Verification

For purposes of valuation and investment analysis, models do not have to be overly complex with numerous different spreadsheets and tedious detail for items that are relatively insignificant. Most people's reaction to receiving a model with thirty different sheets and excruciating detail of operating expenses is to put the model in a drawer and to not perform risk analysis with the model. However, while effective valuation models may be relatively simple, creating a model that is flexible enough to handle different risks; that accurately measures cash flows; that presents the key value drivers and important outputs in an easily understandable and transparent manner; and that does not crash excel because of circular references requires a disciplined approach to excel programming.

From first-hand experience in developing models that are not well designed, the benefits of setting-up financial models in a careful structured manner and using practices that make the models more accurate and stable become obvious. A well structured model can maybe avoid you having the ghastly feeling of, after completing a model, being asked by a supervisor to open and revise a model that was created a few weeks earlier. This feeling often comes from knowing that you will have to review a long and complex formula with multiple "IF" statements that can no longer be interpreted. These types of formulas are generally incomprehensible without completely re-constructing the formula and splitting it up into many different rows.

Some companies require use of a set of "best practices" for programming models. While these practices may help in making models transparent and effective in presenting valuation issues, some people become obsessed with the programming practices and lose sight of the ultimate objective of a model. For example, in order to keep formulas the same across excel columns for the transaction period and subsequent periods, complicated IF statements may be developed that are difficult to interpret. Instead of suggesting there is such a thing as best practice, a list of practices that should make a model easier to interpret and modify is presented below:

- There should be no inputs in any part of the model other than the input page. One of the worst and most obvious problems is to include inputs as part of a formula; these partial inputs are difficult to find and make the models inflexible.

- Make sure that spreadsheet columns are consistent throughout the model and that the formulas for each column are identical (with the possible exception of the very first period in corporate models and acquisition models.)

- Include the units for each column of the inputs and the working sheet.

- Carefully specify the time period of the model using time period codes that define alternative phases of the analysis. The time periods or the time ruler should be the same in each sheet except when annual summaries.

- Keep formulas in the model as simple as possible and clearly delineate how each formula is derived from the inputs (this is often a problem with long "if" statements). Long formulas can be avoided by splitting formulas into multiple different rows and by using TRUE/FALSE switches. Do not use nested IF statements. Ever.

- Divide the model into separate modules, beginning with input modules and make the inputs a separate color (the word module simply refers to a separate part of the model -- it could be a separate spreadsheet page or simply a segment of one sheet.) When entering inputs in one or more modules, operating inputs should be separated from financial inputs.

- Make calculations of operating cash flows in a separate module to measure how the value drivers result in operating revenues, operating expenses and capital expenditures in a working analysis. This means that elaborate revenue or expense calculations should not be directly in financial statements. The calculations in the working sheet should be as transparent as possible through repeating inputs and including all of the factors that are used in making various computations.

- Include separate modules for debt issues, fixed plant assets, working capital and cash balances. The debt module should include the interest rates, interest expenses, repayment mechanics, pre-payment possibilities, financing fees and potential for default. The fixed plant asset schedule should include calculation of book and tax depreciation.

- Work through every single balance sheet item showing the opening balance, additions and subtractions from the account and the closing balance for each the accounts. This analysis should be made for everything single title in the balance sheet ranging from cash accounts to common equity.

- Limit or avoid the use of macros and iterations to resolve circular references as circular references are not present in the real world and fixing circularity makes many risk analysis programming techniques more difficult.

- Use the balance sheet and other items as auditing tools and include a separate "integrity" page of the model to present verification checks. The verification should point to the location of the model errors so you do not have to look around the model to find problems. Include a "dashboard" at the top of each page of the model to monitor the integrity and key outputs of the model.

- Assure that no formulas in the output module of a model affect anything in any other section of the model. This means that you should be able to delete the output section without causing any reference errors in the mechanical calculation parts of the model.

- Test various balances such as the debt balance, the net asset balance, the reserve balance and other items relative to the opening balance. The MIN function together with the opening balance puts a cap on things that can lead to negative balances. For example, the scheduled debt

repayment can be capped at the opening balance – you do not want to pay more than the existing balance back to the bank.

- Use the positive number convention which means that individual items are shown in the model as positive numbers and subtotals are explicitly shown as additions or subtractions. For example, capital expenditures are listed as positive in the cash flow statement with the caption "less: capital expenditures" and cash flow after capital expenditures subtracts the capital expenditures.

The above principals seem obvious when written down in a book. However, in the midst of creating a model to meet a deadline, it is very easy to ignore these principals as they seem to slow you down when working under a tight deadline. Examples of bad practices include entering input data in the fifth sheet of a model; including complicated revenue and expense calculations with long if statements directly in the income statement; forcing the balance sheet to balance using some king of a cash balancing item; computing interest expense without separately listing debt issues and being consistent with time periods. The single worst practice that is often made by otherwise very good modelers is to make formulas that are too long. An example of a formula (for projected prices) that is almost impossible to verify is shown below:

```
=IF(AB5<14,IF(AB2=6,AA39*(1+inflation),AA39),IF(AB5=14,'OperatingInputs'!$E$103/'OperatingInputs'!$E$104,IF(LEN(AB5)=2,AA39,AA39*(1+inflation))))
```

This formula, taken from an actual model, contains a number of bad practices. One problem is that fixed numbers are included in the formula (i.e. the number 14 and the number 6.) The larger problem is that the formula is far to complex to easily verify and audit. This formula could be vastly improved if one would split it up into a number of separate rows where one would show the inflation rate in a separate row, the tests in separate rows and the alternative results of different conditions in various rows. If you would asked to review somebody else's model, it is a good idea to split up formulas like this one. This formula took about fifteen rows and once the more transparent separate rows were presented, several obvious errors were apparent.

A few practical tips for creating a well structured model are described below. Other practical tools that can be helpful in structuring a model are included in the file named "fm.xls" included on the accompanying DVD.

Practical Tips for Good Modeling Practice

This section describes various programming techniques that implement some of the above ideas. If you are interested in general modeling concepts rather than the implementation details or you want to be able to read models but not to program them, you should skip the detailed discussion of practical programming and begin reading the next section on time periods and valuation.

Practical Tip: Short-cut keys and Setting-up the Model Area

In structuring a model it is helpful to set-up the model so that you can work with the model in an efficient manner. The more a model can be created with excel short-cuts rather than using the mouse, the faster you will be able to develop and modify the model. (In some financial modeling courses imposed on young bankers, the mouse is removed from computers so students learn how to navigate around spreadsheets much more quickly, lest they waste a minute in creating collateralized debt securities out of sub-prime loans.) Use of short-cut keys may seem a bit odd when you first use them instead of the mouse, but if you practice, they really can make your work on the model easier. One of the most helpful shortcuts is the combination of the following two keystrokes that allows you to very quickly copy and paste rows in a financial model:

1. Press the SHIFT,CNTL, → (right arrow) at the same time to mark a row, and
2. Press CNTL,R to copy the formula or data to the right.

The problem with this short cut is that it copies the contents of the first cell to each column of the sheet, all the way to the right end of the sheet. To limit the copying of columns to the maximum rows of your sheet – the maximum number of periods that you may forecast, you can hide the columns for which you do not want the item to be copied. To hide columns to the right of the model periods, you can group all of the columns to the right of the last column in your program. To use this method, use the SHIFT,ALT,→ combination to group columns and press the number one on the top left corner of the spreadsheet as summarized below:

1. Shade the entire column of the first column to be hidden (you can used the CNTL, Spacebar combination)
2. Press the SHIFT, CNTL, → to shade the remaining columns in the sheet
3. Use the SHIFT, ALT, → combination to group the remaining the selected columns.
4. Press the Number 1 in the square box at the top left of the sheet.

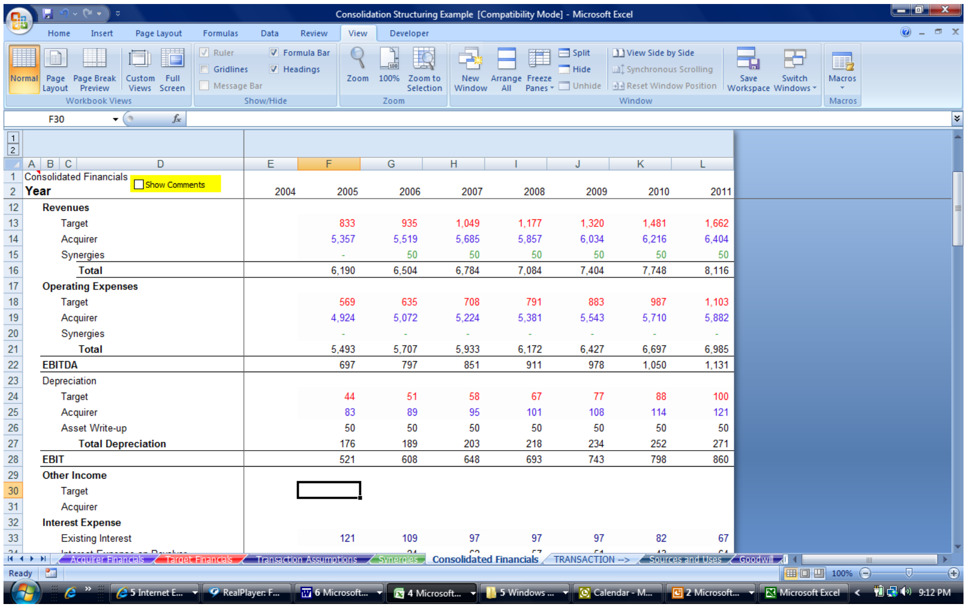
If you need the columns to the right, you can press the number two button instead of the number one key. Results of the grouping approach are shown on the diagram in the next section where the right part of the sheet after the columns have been grouped is grey. Many other short-cut keys and hints are included in the excel background folder of the accompanying DVD and at the website.

Practical Tip: Color Conventions

In a well structured financial model, colors should be used as a guide to what is happening in various cells of the model. This means the colors should not be used to make the model into an attractive piece of art, but it is better that they provide readers of the model with a quick understanding of where the numbers in a cell come from. One principle is that input cells should be colored differently from other cells, generally through using the fill color and the background color. There are few methods to color inputs. A simple method is to use the F5 key and then the press the special key. Then select the constant option and find all of the inputs. After finding the inputs, simply select the selected foreground color. When using the F5 and the paste special, you can create the process in a macro an redo the process every time that you make a change. An alternative method is to use a macro provided in the CD (a set of macros is included on the accompanying CD that allows you to automatically find each input set the color.) It is a good idea to show a color key in the input section or the table of contents of a model.

A second principle is that a different font color should be used for cells in which data comes from another sheet. For example, if price data is transferred from the input sheet to the workings sheet, that cell should have a color to notify users in what sheet they can quickly find the source of the data. A macro that sets the font color of a cell from the tab color of the sheet included with the materials. Other colors can be used for cells that have been computed from the goal seek or the solver and for cells that are computed through the operation of a macro. Finally, cells in which calculations are made from information in the same sheet should not have a font or a fill color.

The example below illustrates a couple of the excel set-up ideas discussed above. The sheet (from an integrated consolidation model) is set-up using the SHIFT, ALT, → method to limit the size of the sheet with the grouping method (when you press 1 at the top left, the columns are hidden, while when the number 2 is pressed, the columns are unhidden.) The red cells come from the target company financials which has a red tab color while the blue cells come from the acquirer sheet that has a blue tab color. Finally, the example illustrates that it is a good idea to make a few small columns on the left of the spreadsheet so that it is clear what rows are sub-totals and headings.



	2004	2005	2006	2007	2008	2009	2010	2011
Consolidated Financials								
Year	2004	2005	2006	2007	2008	2009	2010	2011
Revenues								
Target		833	935	1,049	1,177	1,320	1,481	1,662
Acquirer		5,357	5,519	5,685	5,857	6,034	6,216	6,404
Synergies		-	50	50	50	50	50	50
Total		6,190	6,504	6,784	7,084	7,404	7,748	8,116
Operating Expenses								
Target		569	635	708	791	883	987	1,103
Acquirer		4,924	5,072	5,224	5,381	5,543	5,710	5,882
Synergies		-	-	-	-	-	-	-
Total		5,493	5,707	5,933	6,172	6,427	6,697	6,985
EBITDA		697	797	851	911	978	1,050	1,131
Depreciation								
Target		44	51	58	67	77	88	100
Acquirer		83	89	95	101	108	114	121
Asset Write-up		50	50	50	50	50	50	50
Total Depreciation		176	189	203	218	234	252	271
EBIT		521	608	648	693	743	798	860
Other Income								
Target								
Acquirer								
Interest Expense								
Existing Interest		121	109	97	97	97	82	67

Use of TRUE and FALSE Switches and Model Integrity Page

Setting up a model where a series of mechanical checks can be automatically monitored is effective when building and using a model. A useful technique is placing a "dashboard" on each page of the model that shows key outputs, inputs and sensitivity analysis switches. In addition, the dashboard on each page should show an overall check on the integrity of the model – does the balance sheet balance, is the debt balance positive, are the dividends non-negative, do the sources of cash equal the uses of cash and so forth. Sometimes it is useful to include a series of checks as to whether debt is in default as well as mechanical checks.

An effective way to set up the integrity check of a model is to use TRUE and FALSE logical variables. The use of TRUE and FALSE switches is helpful in many parts of the model. For example, it eliminates the need for painful nested IF statements that can be very difficult to audit and the variables can be used to test covenants and run the model in different modes of operation. A TRUE/FALSE variable can be created by simply using and equal sign (for example, =1=1 is TRUE). Variables that have a value of TRUE or FALSE are helpful because the =AND function can be applied with a series of logical variables to test if the overall value is TRUE (analogous to the sum command for number.) Further, when IF statements are used, they can be used with the TRUE or FALSE in the logical section of the statement. An important verification check is to test whether the balance sheet balances in every period and it is good practice to show each balance sheet item in a different module of the model. The following step by step process illustrates verification with the balance sheet test.

Step 1: After computing the balance sheet, subtract the assets from liabilities

Step 2: In a separate row, use a TRUE/FALSE logical variable (created by setting one cell equal to another) to test whether the difference, after rounding, is equal to zero. (The rounding is necessary because the difference is often not precisely equal to zero if, for example, there is a division by three somewhere in the model).The formula is =ROUND(difference,0) = 0.

Step 3: Once such the TRUE/FALSE result is established for each period, the =AND function can be used to test whether the balance sheet balances in every single one of the periods. Specifically, the AND function is used on a range of TRUE/FALSE logical variables and placed to the left or the right of all of the year by year tests.

Step 4: Link the TRUE/FALSE result from the AND statement to a page of the model that contains other verification checks (for example, in a project finance model or an acquisition model, check whether the sources of funds equal the uses of funds.)

Step 5: Create a separate verification page that combines the balance sheet test with other tests (again using the =AND function) to develop a test for the overall integrity of the model.

Step 6: Identify the sections of the model that have problems using an if statement that uses the title of the test and the result of the test. The if statement has the form:

IF(test,"",title)

For example, when applying the balance sheet test, the test in the above formula would be the aggregate TRUE/FALSE test from the model. The title would be something like "Balance Sheet Test")

Step 7: Once the sections of the model with problems are identified, make an aggregate presentation of all of the problems in the model. This cell can then be placed in each sheet and each sensitivity analysis to allow you to find problems without looking around the model each time. The aggregate presentation has the form:

=problem1&problem2&…..&problem10

Where the problem1, problem2 and so forth come from Step 6. The "&" function allows the text to be put together (as if you were adding things.) For better presentation, it is a good idea to put a space before each title so the problems are delineated.

Step 8: Place the final aggregate presentation of problems with the model in the dashboard that monitors each page of the model.

The figure below illustrates the verification of the balance sheet that feeds into an aggregate balance sheet test. The row labeled "test" uses a switch and the ROUND function to make sure the balance sheet balances in each period. If all of the tests are TRUE, then the aggregate test computed with the AND function is also TRUE.

	8-Sep-08	31-Dec-08	31-Dec-09	31-Dec-10	31-Dec-11	31-Dec-12	31-Dec-13	31-Dec-14
Balance Sheet								
Plant Assets	990.00	1,030.00	1,071.60	1,114.86	1,159.86	1,206.65	1,255.32	1,305.93
Less: Acc Depreciation	-	15.40	66.90	120.48	176.22	234.22	294.55	357.31
Net Plant	990.00	1,014.60	1,004.70	994.38	983.64	972.44	960.77	948.62
Senior Debt	306.90	222.51	140.33	41.04	-	-	-	-
Mezz Debt	336.60	369.92	406.55	446.79	348.01	165.50	-	-
Equity	346.50	422.16	457.83	506.55	635.63	806.94	960.77	948.62
Total	990.00	1,014.60	1,004.70	994.38	983.64	972.44	960.77	948.62
Difference	-	-	-	-	-	-	-	-
Test	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Aggregate	TRUE							

In addition to mechanical tests of the model such as the balance sheet and the debt commitment versus the debt calculated, tests of whether a model is in default on any debt issues may also be developed. In a project finance model and/or a leveraged acquisition model, one of the key questions is whether cash flow is sufficient to pay all debt service and make required payments into debt service accounts and other requirements. If the cash is not sufficient, then defaults occur and ultimately with low enough cash flow, debt cannot be repaid. When the debt cannot be paid, the model should clearly present default on a dashboard. These issues can be addressed with the same type style of programming as the verification tests. For example, a test can be established for default on debt service reserve accounts and a test for negative cash flow. An example of a page that shows verification checks is illustrated in the figure below.

Check Title	Test	Problem Identification	Formula
Sources and Uses	TRUE		=IF(E3,"",D3)
Non Zero Debt Balance	TRUE		=IF(E4,"",D4)
Dividend	TRUE		=IF(E5,"",D5)
Debt Percent > 100	TRUE		=IF(E6,"",D6)
Target DSCR <> Actual DSCR	FALSE	Target DSCR <> Actual DSCR	=IF(E7,"",D7)
Leverage More than 100%	TRUE		=IF(E8,"",D8)
Negative CADS	TRUE		=IF(E9,"",D9)
Fixed Debt Service = Applied	FALSE	Fixed Debt Service = Applied	=IF(E10,"",D10)
Balance Sheet	TRUE		=IF(E11,"",D11)
Aggregate Test	FALSE	Target DSCR <> Actual DSCR Fixed Debt Service = Applied	=F3&F4&F5&F6&F7&F8&F11&F9&F10
Dasboard Presentation ---->		Target DSCR <> Actual DSCR Fixed Debt Service = Applied	=IF(F13="","Model Ok",F13)

To present the final dashboard presentation with different colors depending on whether the model tests are verified or not, conditional formatting can be used. This is a bit difficult because the conditional formatting should use the aggregate test on the verification page, but presentation will probably be made on a number of other sheets. This can be accomplished with the following steps:

Step 1: Create a named range for the aggregate test which is either TRUE or FALSE – for example, aggregate_test.

Step 2: Go to conditional formatting and select the option that allows you to use a formula to determine which cells to format.

Step 3: Create a formula using the range name where you test whether the range name is equal to TRUE and make a format.

Step 4: Create another formula for the range name where it is tested to be FALSE and created another format – for example a red background and a white foreground as demonstrated above.

Step 5: Use the format paint brush to copy the format to other sheets.

Time Period Structure and Valuation

When filling out applications, when discussing your life and when evaluating your performance in various tasks ranging from sporting competitions to employment, the first question that you are generally asked is your birth date. The same principle applies in financial models. The starting point for a well structured financial model should be a carefully defined time line beginning that defines the starting point and ending point of an analysis, as the most fundamental aspect of a person's life that is reported on his or her tombstone is the date of birth and the date of death.

Efficiently structuring the time periods assures that you can you to gauge the effect of issues such as the length of the holding periods of an acquisition, delays in the construction of a large project, lengthening of the life of an investment, or evaluating the amount of time before which a stable growth rate is achieved. From a mechanical perspective, carefully setting-up time periods allows calculations of items such as interest during construction, terminal value, depreciation and amortization, debt service reserve repayments, gain on sale of assets and other items.

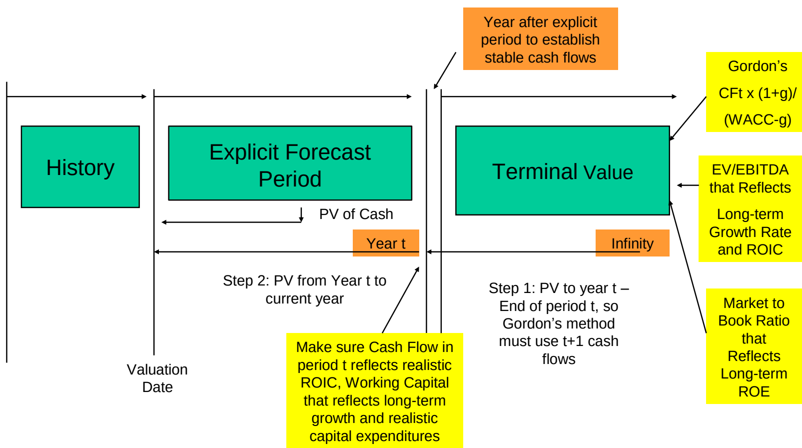
Corporate Models and Terminal Period

A corporate model encompasses a historic period, an explicit forecast period, a terminal period and sometimes a fade period. For a corporate model, the structure of time periods should begin with a base period which is the balance sheet of the final historic period. It is a good idea to label this base period as zero so that the explicit forecast period begins with one and increase thereafter. Given the subjectivity of estimating future growth, it is useful to be construct the model so as to be able to evaluate different

periods before which the explicit forecast period ends. Finally, corporate models can be structured to include a fade period in which cash flow growth declines from the rate achieved in the terminal cash flow period until a stable growth rate is obtained. In the fade period the growth rate in revenues moves from the relatively high short-term growth to a sustainable growth rate over the long-term, the operating margin may move for the current returns to returns that are reasonable to expect in the long-run and capital expenditures move to levels that are consistent with growth rates and the lifetime of the assets. Modelling a fade period may seem to be pretty easy but it can be quite complex as explained later in the chapter.

The diagram below illustrates different time periods in a corporate model and the importance of the assumptions developed for the final forecast period.

Terminal Value in Corporate Model

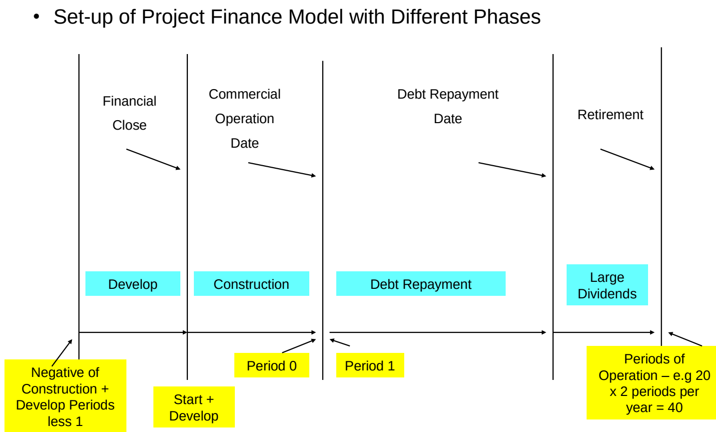


In modeling time periods for a corporate model, complications arise if the valuation date does not occur at the end of a calendar year (for example 1 March). The explicit period should be flexible so that the effects of different growth rates and returns can be evaluated. One of the tricky things in developing a corporate model is making the historic period flexible so that you can new historic periods without re-writing the model.

Project Finance Models and Different Phases

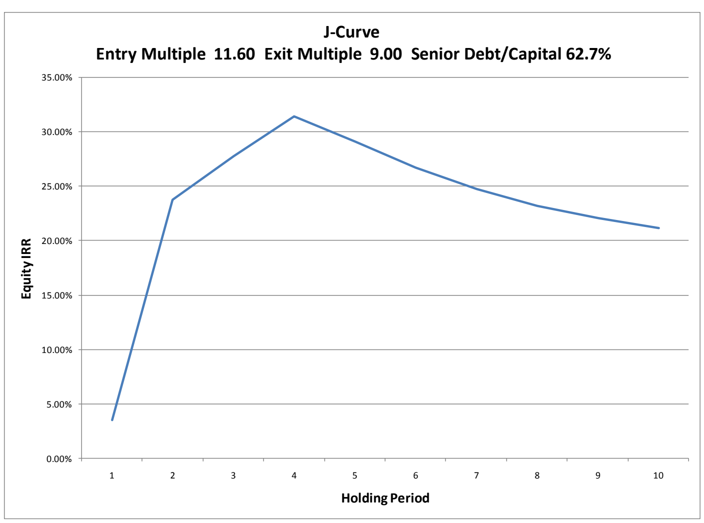
Structuring the dates is particularly important in project finance models where alternative accounting, financing and risks occur in the different periods. The stages that occur when making a new investment typically include the time period when the project is being developed before construction – the development period; the period when construction occurs and investors are putting money into the projects; the period of operation of the project, and finally, the period in which the project terminates. The mechanical calculations in a model and the risks are different for these different time periods. Further, the length of the periods in a model often varies for the different phases of a project. In many models, the construction period is presented on a monthly basis in order to accurately measure interest during construction since the calculation requires accumulation of debt for each month. On the other hand, when the plant begins operation, the model switches to semi-annual periods because of debt is repaid on a semi-annual basis. In order to construct time periods, one can create switches that define each phase of the project as well as the important millstone dates such as the financial close and the commercial operation date. The programming of different phases can become quite complex if the millstone dates do not start at the beginning of a month and if there are different time periods modeled in each phase of the project. The essential practice is to make a period code which is one at the commercial operation date, negative during operation and development and measures the age of the project. The figure below

illustrates how various stages of a project can be modeled with a period code. The mechanics of developing the various switches is discussed in the section below.



Acquisition Models – Transaction Period and Exit Period

In the case of acquisition models, it is also important to spend some time setting-up time periods. In this case, separate switches can be developed for the acquisition period, the holding period, and the terminal period. The acquisition period should be a separate period in the model that only lasts one day so that the mechanics of the on-going calculations are not mixed up with the transaction assumptions. The period subsequent to the acquisition period can be a fraction of a year followed by annual periods until the final sale period. The exit period should also be separate from the holding period in order to isolate on assumptions with respect to the sale of the company. Developing periods in this manner allows the model to handle movements in the transaction date as well as alternative holding periods of the investment. With the holding periods defined, a J-curve illustrating how the rate of return is affected by the length of time between the purchase and sale can be established as illustrated in the graph below.



General Method for Structuring Time Line

It may seem as though setting up a time line is trivial. However setting-up dates and various time period codes that classify various phases of a transaction or a forecast is an important part of the process of developing all of the different model types. A few issues that make the time line process more manageable include:

- Reserve a separate place in the model for the time line, whether on a separate page or a separate place above the beginning of the operating analysis.
- Begin the process by defining some kind of age variable (in your personal life, your age tells a lot about you).
- Include the dates of the model beginning with the first date of history, the date of the financial close or the date of the transaction.
- Explicitly define the periodicity of the model in terms of the number of months per period, the number of periods per year and the number of days per period (using either a 360 day basis with the DAYS360 function or a 365 day basis by subtracting the end date from the beginning date).

in the model your Often keep the date inputs and the time line calculation in a separate place

Discuss finding the number of months per period and the period code -- diagram

Use of SWITCHES to find the months per period

Discuss consistency of time line in different sheets

Use of MATCH and INDEX for transferring data

Practical Tip: TRUE and FALSE Switches for Modeling Time Periods

Use of the logical variables that have a value of TRUE or FALSE can be very helpful in a model because TRUE is equal to one and FALSE is equal to zero and because these switches eliminate the need for long IF statements. A switch can be created by simply using and equal sign (for example, = period or period <= 0). It can also be created using and AND, OR, or NOT function (for example, AND (period > 0, period <= retirement date) defines a switch for when the plant is operating. Establishing the TRUE and FALSE statements is also effective together with IF statements. One can simply use the TRUE or FALSE in IF statements and make the statements much easier to read.

Mechanically, the definition of various phases in a model can be developed by inputting various dates and then programming variables that contain switches. These switch variables which have a value of TRUE or FALSE can be used to set-up dates and program many variables that differ as a function of the phase of the investment. For example, various items may be different in the terminal period in a corporate model. To make programming less laborious you can make a variable that has a value of FALSE for each period except for the terminal period, which has a value of TRUE. If the model is set up beginning with zero for the last historical year, then the logical variable for the terminal period is simply programmed to be a test when the terminal period equals the time period counter. Examples of use of the switch variable are shown below:

Construction Expenditures =	Total Cost/Construction Period x Construction Period Switch
Debt Balance =	IF(historic period, actual amount, opening balance – repayments)
Terminal Proceeds =	Terminal EV/EBTIDA Ratio x EBITDA x Terminal Switch
Interest During Construction =	Interest Accrued x Construction Switch
Stable Capital Expenditures =	Capital Expenditures/Depreciation x Depreciation x Stable Switch

A financial model can be established on different periodic bases – annual, monthly, quarterly or semi-annually. It may seem a bit ridiculous to create a model with monthly information for ten years into the future when it is very difficult to predict what will happen one year from now. However, creating periods that are more finely defined than twelve month increments can be important in avoiding circularity and in reflecting the structure of alternative debt instruments. While it may seem a lot more complex to make a periodic model, with a bit of investment in creating switches and dates, the periodic modeling does not have to be painful.

Tip: Computing Start and End Dates for Each Period

Once the period length for project phases, the switches, and the period codes have been defined, the dates of the model can be established. In general, it is not useful to work with days when incrementing dates. For example when increasing a date by one month, the new date cannot be incremented by simply adding numbers to the prior date. For example, in establishing the next month, you cannot add 30.5 to the date for the previous month. Instead of working with days, it is helpful to use the EDATE function or the DATE function. When using the EDATE function, the number of months is used to increment a date: EDATE (prior period, periods per year). If the DATE function is used, the YEAR, MONTH and DAY arguments of the function should refer to the previous date and the period per year should be added to the MONTH argument. Given the definition of periods for year from the switches above, the DATE function would be DATE(YEAR(prior date), MONTH(prior date) + periods per year, DAY(prior date)). After the dates have been computed, it is a good idea to explicitly show the start date and the end date for the period and the number of days in the period at the top of each page of a model. In addition, the number of days in a 360 day period should be shown using the DAYS360 function so that interest expense or interest income can be computed per the appropriate convention.

To set-up a model that includes different project phases as in a typical project finance model, a few counting techniques are useful. First, the length of the construction period should be defined in periods (e.g. months if the model is monthly during the construction period). If the beginning of construction and the beginning of operation is input as a date, then the construction period can be defined using a 360 day year where each month has 30 days. To compute the construction periods, use the DAYS360 function and enter the start date of construction and the commercial operation date (DAYS360(start date, completion date), then divide this number by the days per period (30 for a monthly model). To illustrate this process consider the following example:

Start date of construction:	1-March-2010
End date of construction:	1-December-2015
Total Days of Construction DAYS360 (begin, end):	270
Construction Periods (Divide by 30):	69

Tip: Setting-up Time Periods in Project and an Acquisition Model

The step by step process for setting up dates at the beginning of the sheet for a project finance model and an acquisition model includes the following:

Step 1: Input months per period for various phases of the project – typically one month for construction period and six months for operating period.

Step 2: Develop period code – this is an essential part of the process, the last date before operation is period zero and the project begins its life in period one. For an acquisition model, define the data of acquisition as zero and begin counting for subsequent periods. It does not matter at all that the length of some periods is different than other periods. In a project finance model, the start period of construction is the negative of the number of construction months minus one. For example if the start date of construction versus the completion date yields 40 months, the first period is

negative 39. Then, the first period of construction will be zero as desired. (Note: it is a good idea to hide remaining columns)

Step 3: Develop switches (TRUE/FALSE) for different phases and important dates – construction period, operation period and terminal period. For example, a switch for the repayment period may be developed that extends from the commercial operation date to the final repayment date as follows:

Repayment Switch = AND(start date >= Commercial operation, end date<= final repayment date)

Step 4: Correspond the months per period to the switches. For example, for the construction period, the months per period is one while after the construction period, the months per period is six.

Months per Period = IF(Construction Period, 1, 6)

Step 5: Enter the dates using the EDATE function. Show both the beginning date and the ending date. The first beginning date is the established date and the ending date is the EDATE function with using the months per period. The beginning period in the second period is the ending period plus one day.

Beginning Period Date = Ending Period Date + 1
Ending Period = EDATE(Beginning Period, Months per Period) - 1

Step 6: Adjust the ending period so that it cannot be greater than the retirement date. The retirement date can be computed as the start of construction date adjusted for the length of the concession period as illustrated below. The MIN function can be used to make sure the ending date does not exceed the retirement date as illustrated below:

Retirement Date = EDATE(Construction Start, Concession Period x 12)
Ending Date = MIN(Retirement Date, EDATE(Beginning Period, Months per Period) – 1)

Step 7: Compute the number of days per period and the days in 360 day year (first period next year)

If the dates do not begin at the first day of the month, then the EOMONTH function should be used rather than the EDATE function. Further, the ending month must change fir different millstone dates including the start of the project development, the financial close and the commercial operation. For all other months, the ending date is the end of the starting month that can be computed with the EDATE function. A final complication results because the time periods are not constant and must be adjusted if the start date is more or less then the middle of the month.

Tip: Computing the Age in Years in a Periodic Model

When developing where time increments are not expressed on an annual basis (e.g. a monthly model or a quarterly model), it is often convenient to express keep track of the age in years. Many inputs such as the credit spread, the operation and maintenance expense, production changes, the extraordinary maintenance and other variables depend on the age of a project rather than the calendar year and these variables are often expressed on an annual rather than a periodic basis. Computing the age of a project seems to be a simple issue, but it can be a little tricky. This is particularly true in cases where the number of periods is not constant over time; for example where a detailed monthly analysis is deemed necessary for the initial few years of a project life after which a quarterly model is used.

To compute the age of a project in years, a two-step process is helpful. The first step is computing a variable that simply counts the number of periods in the year. For example, in a monthly model, you would count from one to twelve and in a quarterly model you would count from one to four. The second

step is to compute an age variable in years which increases once a new year has been reached. Increases in the age occur when the counter variable has a value of one. Difficulties in this process involve making sure that the counter begins with a value of one at the start of commercial operation and that counter variable re-starts when the periods of the model change. This step-by-step process is illustrated below:

Step 1: Compute a period counter variable. In a simple project finance model, this could be calculated using an IF statement where the counting re-starts after the maximum number of periods is reached:

IF(last period counter = maximum periods, reset to one, increment counter by one)

This technique does not work if the number of periods changes in the middle of the model. For example, you may want to make the model on a monthly basis for a couple of years while the project is being phased-in and then change to semi-annual modeling. In this case, the maximum period is not always the same and the increment is also not the same.

To account for this the equal sign can be change to a greater than or equal sign. In addition, to make sure that the age variable begins counting at the end of the construction period, the counter should use the operating switch to begin the period counting process. In the equation below, the increment could be one month when the monthly counter is in place and then six when the model switches to semi-annual modelling.

IF(last period >= max period, reset to one, increment prior period by variable counter)

Step 2: Increment the age variable when the counter is equal to one. This is simply like having a birthday on one day (or month, or quarter) and increasing your age in years on your birthday.

IF(counter variable = 1, increase age, don't increase age)

Tip: Converting Periodic Data into Annual Data

It is simple to annualize periodic cash flows once the fiscal year has been established. This can be accomplished by listing the year below the date and then using the SUMIF function to sum the periodic cash flows within the year. Converting a periodic model into an annual model is often necessary for presentation and can be very useful in reviewing the model. To demonstrate the process, the establishing the fiscal year is discussed and then the process of using the conditional sum is described.

Establishing the fiscal year can be demonstrated by considering the example of Microsoft Corporation. For this company, the fiscal year 2007 ends at June 30 meaning that a year presented in financial statements and covers the period from July 1 through June 30. In this case, one would define the fiscal year by defining the month of June as the last month. For programming purposes, January through June correspond to the current calendar year (2007) and the later months, July through December, correspond to the prior fiscal year. In project finance models, for convenience, the fiscal year should in the month just before commercial operation. With this assumption, the first year covers a full year of operation. For example, if construction ends in May and the project begins in June, the fiscal year should end in May. Then, the first fiscal year would cover the period from the beginning of June at commercial operation to the next June. Once the month of the fiscal year is established, one can use the YEAR function along with the MONTH function along with an if statement to determine the fiscal year of alternative periods. For the example above where the fiscal year ends in May, if the month is less than to June, the fiscal year

equals the calendar year. On the other hand, when the month is greater than June, the fiscal year is the next calendar, or the calendar year plus one.

Once the fiscal year has been established, the periodic cash flows can be converted into annual cash flows for balance accounts that record the balance at end of the year and for cash flow or profit and loss accounts that accumulate amounts into the annual periods. The following step by step process walks through the process and allows one to very quickly convert periodic cash statements to annual statements.

Step 1: Compute Fiscal year

If the month of the opening date is ***less than*** the fiscal month, (e.g. June) then the fiscal year is the same of the calendar year (e.g. 2007). (For example, for months of January through May, the year is 2007.)

If the year of the opening date is ***greater than or equal*** to the fiscal month (e.g. July), the year is the calendar year plus one (e.g. 2007+1). (In the example above, June through December are set to 2008.)

Step 2: Copy titles of cash flow, balance sheet and other items to a separate section or a different sheet. Enter the year of for the report on the top of the sheet as well as the month number of the fiscal year. Then use the date function to create the ending date of the fiscal year (see the figure below).

Step 3: Use a TRUE/FALSE switch to identify codes that are accumulated over the year and the accounts in which balances are taken from the end of the fiscal year period.

Step 4: Apply the SUMIF function, where the initial range is the fiscal year definition, the criteria is the year and the sum range is the cash flow item. To make this work shade the entire row of the fiscal year in the periodic section of the model (click on the row number to shade the entire row) and then fix the references (press the F4 key). Next, refer to year entered for the report in step 2 above and use a relative reference to lock-in the row number but not the column name (press the F4 key twice). Finally, refer to the range to be summed by clicking on the entire row without locking in the row number or the column number. This process will work for the cash flow items to be accumulated over a period.

Step 5: Use a similar process using the SUMIF function to apply to the balance accounts. In this case the sum range is the date itself and the criteria is the ending day of the fiscal year. This means that the only items are summed when the fiscal year data used in the criteria of the SUMIF formula is the same as the date in the periodic section (sheet of the model.) To make this work, shade the entire row of the end date in the periodic section of the model (click on the row number) and then fix the references (press the F4 key). Next, refer to fiscal year end entered for the report (see the diagram below) and use a relative reference to lock-in the row number but not the column name (press the F4 key twice). Finally, refer to the range to be summed by clicking on the entire row without locking in the row number or the column number as with the accounts to accumulate.

Step 6: Use an IF statement with the TRUE and FALSE switches (create a relative reference on the column name of the switch) and copy the same formula for each row in the sheet.

Financin	Month of Fiscal Year		9	9	9	9	9	9	9	9	9
	Year		2007	2008	2009	2010	2011	2012	2013	2014	2015
	Fiscal Year End Day		30-Sep-07	30-Sep-08	30-Sep-09	30-Sep-10	30-Sep-11	30-Sep-12	30-Sep-13	30-Sep-14	30-Sep-15
Power Output		**Accumulate/ Balance**									
	Plant Capacity (kW)	FALSE	600	600	600	600	600	600	600	600	600
	Capacity Factor	FALSE	29.7%	29.7%	29.7%	29.7%	29.7%	29.7%	29.7%	29.7%	29.7%
	Annual Degredation Factor	FALSE	0.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
	Daily Degredation Factor	FALSE	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Degredation Index	FALSE	1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92
	Capacity Factor with Degredation	FALSE	29.7%	29.4%	29.1%	28.8%	28.5%	28.3%	28.0%	27.7%	27.4%
	Availability Period	FALSE	1.00	1.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00
	Plant Availability	FALSE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Number of Hours in Period	TRUE	-	8,784	8,760	8,760	8,760	8,784	8,760	8,760	8,760
	Gross Generation (MWH)	TRUE	-	1,549.77	1,530.23	1,515.08	1,500.08	1,489.25	1,470.48	1,455.92	1,441.51
	Paracetic Load	TRUE	-	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
	Total Net Generation (MWH)		-	1,529.77	1,510.23	1,495.08	1,480.08	1,469.25	1,450.48	1,435.92	1,421.51

Tip: Beginning a Model with Dates that do not Start at the Beginning of a Quarter or a Month or a Year

In most situations an acquisition or a project finance venture or even a valuation analysis with a corporate model does not conveniently begin on January 1st of a year for annual models, or April 1st, July 1st or October 1st for a quarterly model and the beginning of the month for a monthly analysis. Many times it is not worth the effort to incorporate start dates that are not the beginning of a period and one can simply assume the project or acquisition occurs that the beginning of the relevant period. However, occasionally it may be necessary to incorporate start dates that are not at the beginning of a period. Unfortunately, this is a painful process and there is no quick and easy trick to accomplish the task. A general approach to deal with the issue of start dates that are not consistent with desired period begin and end dates is discussed below:

1. First, you should establish the date of the first full period of a model. For example, if the start date of a project is 19th of January and the model is a monthly model, then the date of the first full period is 1st of February. On the other hand, if the model is a quarterly model, the first full date is 1st of April.

2. The date of the first full period can be determined by using the MATCH function or the VLOOKUP function to compare with dates that correspond to the end of a year, quarter or year. For example, if the first project begins on 19th January and the fiscal year is June and an annual model is used, then the beginning of the first month can be computed by comparing 19th January with a list of dates beginning with the first of the month. In this case the 1 February would be selected.

   This date is used as the end of the first period and the beginning of the second period. Once the second period is established, the end dates of subsequent periods can be established as described above using either the EDATE or EOMONTH function.

3. Given that periods of the model will be uneven – specifically that the number of days in the very first period is different from days in the other periods, the technique that computes daily growth rates and then compounds the growth on a daily basis should be applied as described above.

4. If you are entering factors that depend on the life of a project or the life of an acquisition – for example the growth rate for the first year of an acquisition may be negative – one must allocate the growth between periods. This occurs in periods when the year changes. For example, if the project begins on 1st September and the model is annual, some of the first year growth rate must be allocated to the second full year of the model. To accomplish this one can create a partial year factor and compute the percent of the period attributable to the current age and the percent of the project attributable to the prior age.

It is simple to annualize periodic cash flows once the fiscal year has been established. This can be accomplished by listing the year below the date and then using the SUMIF function to sum the periodic cash flows within the year. To demonstrate the process, the establishing the fiscal year is discussed and then the process of using the conditional sum is described.

Establishing the fiscal year can be demonstrated by considering the example of Microsoft Corporation. For this company, the fiscal year 2007 ends at June 30, 2007 and covers the period July 2006 through June 2007. Here, one would define the fiscal year as June. For programming purposes, January through

Inputs, Workings Analysis and Working Capital

In discussing the structure of various models above (using different diagrams for the various model types) each model had a lot in common. For example, each model began with an input section and model ended with a balance sheet. Further, each model includes a working section that computes revenues, expenses and capital expenditures; each model type has a debt schedule; each model includes a depreciation section and each model contains an income statement and a cash flow analysis. These components of models that are common to the different models are discussed in the next few sections. This section begins the discussion of common model elements through describing model inputs and the initial section of the model that should compute revenues, operating expenses and capital expenditures.

Structure of Inputs

When setting-up inputs, the data should be classified in a manner so that the data can be easily found. The inputs should be on the same spreadsheet page (or set of pages) and the relevant input categories should be grouped together. Generally, the inputs should begin with timing parameters followed by operating inputs, financing inputs and valuation parameters. Inputs can be structured on a period by period basis across a spreadsheet page or they can be entered in alternative time increments where users can insert added variables as illustrated below. In a corporate model, the inputs are often entered next to historic values and it may be convenient to use conditional formatting. It is often useful to enter inputs on an annual basis even if the model is computed on in monthly or a quarterly time increments. The guiding principle should be to put yourself in the shoes of a user who does not waste his or her life in front of excel sheets. If alternative scenarios are developed, which is generally the case, a separate master scenario page should contain all inputs for the scenarios including the base case and alternative scenarios. The scenario inputs should be presented in a clear and simple manner so that users are not afraid to run the analysis.

ANNUAL ASSUMPTIONS FOR OPERATING INPUTS										
Dates from Transaction and Timing Sheet										
First Historic Date	31-Dec-01									
First Historic Year	2001									
Final Historic Year	2011									
Historic/Projection Year	2001	2002	2009	2010	2011	2012	2013	2014	2015	2016
Historic Period	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE
Assumptions for Revenues										
Annual Industry Growth										
Scenario Number	1									
Base Case		4.72%	16.60%	20.30%	-7.91%	5.50%	5.50%	5.50%	5.50%	5.50%
Bear Case		4.72%	16.60%	20.30%	-7.91%	1.00%	1.00%	1.00%	2.00%	2.00%
Bull Case		4.72%	16.60%	20.30%	-7.91%	6.00%	6.00%	6.00%	5.00%	5.00%
Base Case		4.72%	16.60%	20.30%	-7.91%	5.50%	5.50%	5.50%	5.50%	5.50%
Historic Market Share	35%	31.15%	28.17%	24.53%	25.35%	0.00%	0.00%	0.00%	0.00%	0.00%
Product Price	195.00	199.07	227.77	229.97	221.79	228.44	235.30	242.35	249.63	257.11
Assumptions for Operating Costs										
Variable Cost	65.00	69.09	82.99	86.17	92.80	95.00	97.38	99.81	102.30	104.86
SG&A percent	15%	15.27%	15.70%	15.67%	15.37%	15.37%	15.37%	15.37%	15.37%	15.37%
Assumptions for Capital Expenditures										
Company Additions	600.00	0.00	0.00	0.00	0.00	200.00	0.00	100.00	130.00	100.00
Cost per Unit of New Capacity	0.00	500.00	574.34	585.83	597.55	612.48	627.80	643.49	659.58	676.07
Maintenance Capacity Percent	2.44%	2.44%	2.44%	2.44%	2.44%	2.44%	2.44%	2.44%	2.44%	2.44%

Making the inputs easy to understand seems trivial, but can be an essential part of making a model useful. The inputs should be set-up in a way that anybody can easily find the inputs and understand exactly what each input means. For example, a model has a input labeled “development percent” would be confusing because one has no idea what is the basis for the percentage. Second, the inputs should allow the model to be adjusted and not be restrictive. For example, when there is one inflation rate applicable to all future years, the model has limited flexibility. Third, the inputs should be arranged in a logical manner and grouped together by categories. Separate sections can be shown for inputs for the general transaction – dates, purchase prices and so forth; operating revenue and expense drivers; capital expenditures; financing parameters; and tax assumptions and other items. Fourth, no matter how tempting, outputs from the model should not be mixed together with the model inputs. Finally, when using the inputs in other sections of the model, the inputs should be repeated and not used in the middle of the calculations.

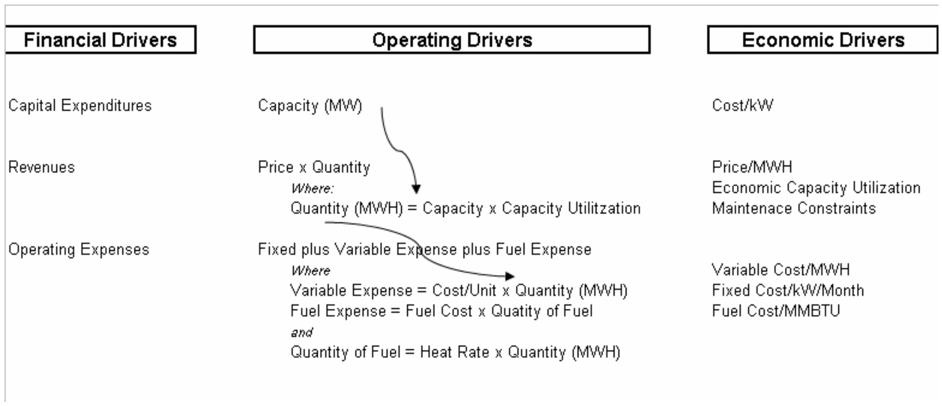
Value Drivers; Supply Driven Models versus Demand Driven Models

Most time in the valuation and modeling process should concentrate on statistical and economic analysis of the inputs that are have the most significant effect on value – the value drivers. The art of modeling involves quickly identifying these value drivers and then developing reasoned projections of what could happen to these inputs in the future. This analysis can range from simple graphing of historic data to complex regression analysis of mean reversion tendencies to judgment with respect to political risks. Modeling and valuation mistakes discussed in the last chapter were not due to incorrectly structuring a model or having a financial model that was too simple; they were generally the result of not using valid economic and financial principles in developing inputs to the valuation process. The general objective of programming tips presented in this chapter is that you will hopefully have more time to study the drivers of value.

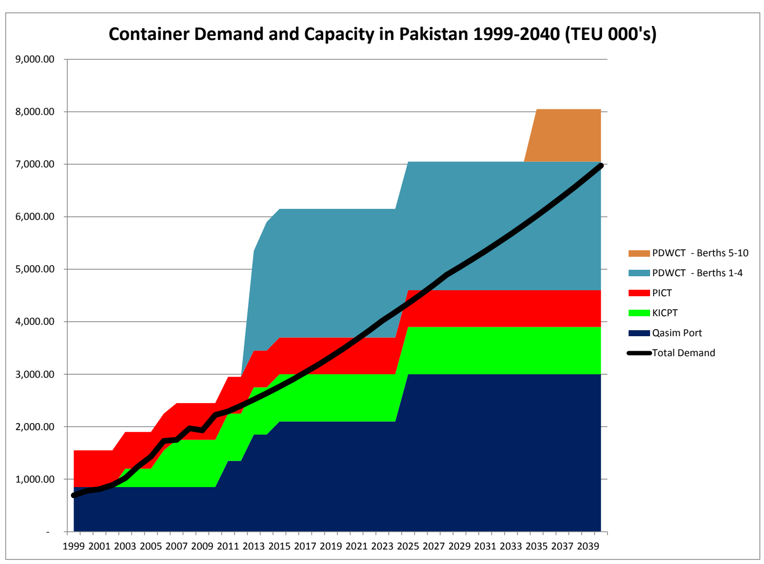
The most important part of the modeling process is to accurately define and analyze input items that drive the value of an investment and effectively present how the risks of the value drivers affect the ultimate value. Value drivers are economic variables such as demand, price, cost of capital expenditures per unit and the fixed and variable cost structure of investments that determine the level of three items that are the key to any model – revenues, operating cost and capital expenditures. True value drivers are not items such as revenue growth, operating margins, return on investment or the ratio of capital expenditures to sales. These are statistics are the result of the economic position of a company or a project, not the items that are the ultimate source of value and risk. Subsequent parts of the book deal with how to develop inputs for prices, demand growth, cost structure, discount rates and other inputs. These inputs can be studied by reviewing historic data, performing statistical analysis, applying marginal cost concepts, and considering industry structure. In addition the value drivers should use judgment as to whether sudden non-linear changes can occur, industry expertise and perhaps mathematical simulation. This section describes more mundane issues concerning how to structure, document and present inputs in a financial model.

When developing a model it is helpful to think about whether profits and cash flow of a company are primarily driven by demand and market share or commodity prices and cost management. The former type of model is referred to as a demand driven model while the latter is called a supply driven model. The starting point for the working section of a model should generally be the capacity of the company in a supply driven model and the industry-wide demand for the product in a demand driven model. To demonstrate the difference between demand and supply driven models consider an upstream oil project. The most likely place to begin the upstream model is with the capacity of the oil fields in terms of oil and gas reserves meaning the model would be supply-driven. You would not begin with an analysis of the worldwide demand for oil because oil prices the company operates in a commodity business and it will most probably sell whatever it can produce. Alternatively, for a company operating in a limited market region that may have market power, the model would begin with demand for the product and market share of the company. The diagram below illustrates modeling of an electricity plant for a supply driven models. The drivers for capital expenditures, revenues and operating expenses are all determined by the capacity of the plant. Economic drivers of revenue, operating expense and capital expenditures include

the cost per unit of building the plant, future trends and volatility in prices, the capacity utilization of the plant; and, the variable and fixed costs of operating the plant. (One can argue that the capacity utilization of the plant is related to demand rather than supply factors and that the model is also demand driven as it depends on the overall growth rate of the industry and the competitive position of the plant.) Chapter 7 addresses how to evaluate value drivers associated with prices and utilization rates.



For demand driven models it is best if possible to begin with the capacity and/or demand of the company or project as well as the entire capacity and demand in the industry. Case studies in chapter 1 demonstrated that many valuation mistakes are made when over-supply occurs in an industry or when demand declines. With surplus capacity, prices can move down to the short-run marginal cost of production as companies fiercely fight for market share. Surplus capacity can arise when the return on investment for firms in an industry are relatively high and when entry of new firms is not limited. A recent example is the solar manufacturing industry where high market valuation and strong returns encouraged addition of new capacity. The new capacity led to dramatic price reductions and declines in market value. An example of structuring a model that begins with industry demand and supply is illustrated on the graph below. Even if inputs for the industry demand and supply cannot be precisely obtained, the idea of understanding projected supply and demand conditions relative to historic levels is a worthwhile step.



Once the industry supply and demand is established, estimates of market share and prices can be estimated. The manner in which volume demand could be established from demand estimates could be established from a step by step process something like the following:

Step 1: Compute the industry demand. Possible approaches to compute future demand include regression analysis, evaluation of historic volatility, extrapolation and judgment.

Step2: Compute the industry supply from exiting supply, expected new additions and expected retirements. If inputs for new capacity are structured with different years, the SUMIF function can be used to put the capacity together in a table. The SUMIF function can accumulate capacity for each company by using the inputs for each year and the year of the model as the criteria.

Step 3: Compute the industry wide margin and attribute the industry margin to the company to develop company volumes as illustrated using the equation below.

Reserve Capacity Percent = Industry Capacity/Industry Demand

Company Demand = Company Capacity/Reserve Capacity Percent

Step 4: Evaluate the price of the product as a function of the reserve capacity percent and the surplus capacity.

Computing Periodic Inflation in Working Analysis

When setting-up the working section of a model, it may seem that establishing an inflation index is straightforward and simply is a matter of multiplying one plus the inflation rate by the prior inflation index. However, even with making inflation projections, various problems can arise when time period lengths change and when intervals are used for inputting the inflation rate and when the starting point for inflation indices are not clearly laid out in the input section.

Interest rates and inflation rates are generally input into a model as annual rates. When modeling inflation rates with non-annual periods, it is not accurate to simply compute the fraction of the year and multiply this by the annual percentage in a periodic model. This can result in overstatement of interest or inflation because amounts will be compounded in a model. For example, assume the annual inflation rate is very high, say 120%. If the real expenditure for the year before the year’s inflation is 100, then it would be 220 including the inflation. If 10% is assumed per month, then by the end of a year with, the inflation index compounds to 3.38 rather than 2.20. To resolve this problem of over-compounding, a periodic rate should be calculated where the implied rate without compounding is derived.

End of period expenditure = Beginning of period x (1+periodic rate) ^ periods

and,

End of period expenditure = Beginning of Period x (1 + annual rate)

or,

(1+periodic rate) ^ periods = (1+annual rate)

(1+periodic rate) = (1+annual rate) ^ (1/periods)

periodic rate = (1+annual rate)^(1/periods) - 1

To practically apply the above formula, you can compute the days in a period (it is best to use the DAYS360 function and keep the periods constant) and then use the days in the period divided by 360 in the above formula as illustrated below.

Periodic Rate = (1+annual rate)^(days360/360) - 1

Alternatively the periodic rate can be computed using the months per period:

Periodic Rate = (1+annual rate)^(months per period/12) - 1

Finally, when establishing the inflation rate one should be careful about the start date. When inflation assumptions are made, the data is input in real terms excluding inflation. One should know the date at which the real data is input and the start date of the inflation index. To start the inflation index at the appropriate date, you can create a switch and only turn on the inflation rate after the inflation start. This will keep the inflation index at one until the beginning of the inflation period.

Working Capital

The working capital module is also generally very simple from a programming standpoint. In a model, working capital includes trade working capital and does not include cash, short-term securities, short-term debt or current maturities of long-term debt. To compute working capital, various working capital ratios such as the days receivable outstanding are input. These ratios together with the revenues and operating costs define the level of working capital. For example, if the days outstanding are 30, then one month of revenues is not collected, or about 8.33% of total revenues. Of course, the working capital section must be developed after revenues and expenses have been computed. After computing the total current assets and current liabilities, working capital is computed as the difference between the two amounts. Finally, the change in working capital is the current period working capital less the prior period working capital.

One complexity in computing working capital can involve computing inventories and accounts receivable during periods of declining demand. In a detailed model, the production can be computed separately from demand. Additions to inventories can be modelled as a function of production while deductions from inventories can be modelled as a function of demand. If there is a sudden reduction in demand without a similar reduction in production, the inventory balance will increase. In other cases, the level of accounts receivable can be modelled as a regression equation as a function of economic variables and prices.

Excel Tips for Data Validation

When entering data, the data validation tool in excel can be useful in assuring that the data you have entered is valid. The tool can also be useful in documenting the source of inputs. You can make sure the data is entered is in the intended range (such as a number between zero and one), you can make sure the sum of a series of data inputs accumulates to one (such as depreciation rates) and you can assure that a data input is within a given set of numbers. To use the data validation tool, select the validation option from the data menu. If you simply want to make sure the data is a decimal value between zero and one, select the decimal option from the settings option. Then enter zero for the minimum and one for the maximum. To validate that the sum of depreciation rates sum to 1.0, Data validation techniques; use of match command to link data to appropriate periods in a flexible manner.

Setting-up Scenarios with Forms, and INDEX Command

One of the most important uses of models is to develop risk analysis. To prepare the model of risk analysis, one should set-up the model in anticipation of the risk analysis through entering different possible scenarios in the data input section. The task is to enter the data without inordinately cluttering up the model. This can be accomplished through entering data and then grouping the data. In addition, use of forms together with the INDEX or CHOOSE command is generally effective. The process of setting-up scenarios is summarized below:

Step 1: Enter different scenarios for an input item by simply typing the different scenarios on a set of rows.
Step 2: Enter a row number corresponding to one of the scenarios in an open cell somewhere in the spreadsheet.
Step 3: On a blank row below the list of scenarios, use the CHOOSE or the INDEX function along with the selected row to create the chosen scenario (the row number should be fixed so the function can be copied across the rows.
Step 4: Use the selected scenario as the variable in the model.

If you would like more specific guidance on creating scenarios, please refer to the file named scenario and sensitivity analysis on the CD.

Tip: Looking up Data with MATCH and INDEX

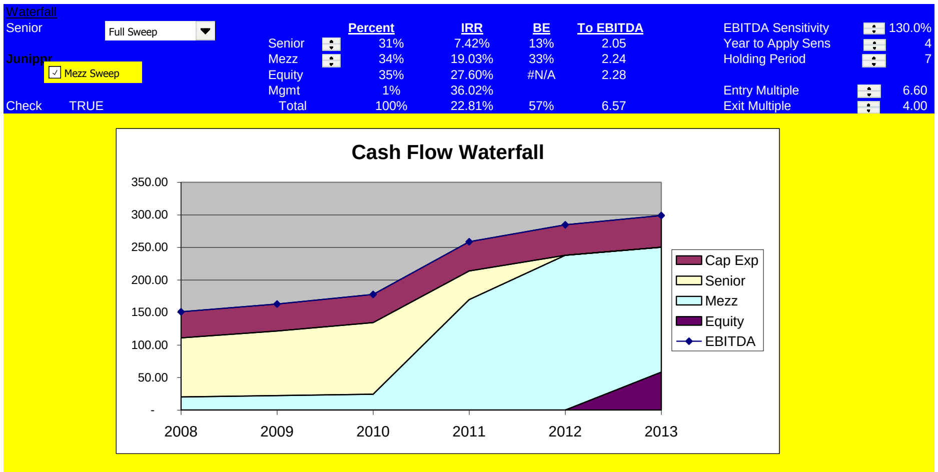
In developing indices of inflation, growth, and loan pricing grids, inputs can be presented using a grid that shows the from date, the to date and the input item. For example, the credit spread on a loan may vary by year and also according to a financial ratio as shown in the example below where the model is created on a monthly basis, but many of the inputs are developed on a calendar year basis.

Credit Spread					
DSCR		From	2009	2012	2015
From	To	To	2012	2015	2050
1.00	1.3		1.50%	1.60%	1.70%
1.30	1.5		1.30%	1.40%	1.50%
1.50	2.5		1.25%	1.35%	1.45%

In order to array the credit spreads in the above table with both years and the debt service coverage ratio, one can use either VLOOKUP or the HLOOKUP functions or the MATCH together with the INDEX function. To array the values where there is space between the values, the “from” year can be used with the lookup or the match commands. The MATCH command can use either 1, 0, or -1. The value of 0 means there must be an exact match of the value, while the 1 is used for ascending values and -1 is used for descending values.

Setting-up a Dashboard

When there are multiple sheets in a model, it is nice to show a dashboard in which you can change different items and you can show outputs as shown on the example below. It is also helpful to show the model verification switch in the dashboard. This is very simple to add to each sheet after you have worked on the model if you use range names for the output variables and you have structured forms in the model to work with multiple sheets. The simplest way to create forms is to make an extra working sheet and refer the cell links to different sheets. In this way the forms can be copied from one sheet to another while retaining the cell links in the appropriate sheet. When creating a dashboard, it is useful to use range names for all of the inputs and outputs shown on the page so that the dashboard can easily be copied to added spreadsheet pages. The example below illustrates use of a dashboard for a leveraged acquisition transaction. The drop-down boxes and spinner boxes may seem a bit like a gimmick, but they can be used to effectively summarize the key inputs and the key risks in a transaction. With these buttons, one can evaluate different capital structures, different operating cash flow levels in terms of return as well as risk. In this case, the risk is measured as the break-even cash flow that can support the level of senior and mezzanine debt before the return falls below the risk free rate.



Use of Range Names to Structure and Document Models

When entering data, the cell references such as "B2" can be renamed using range names such as "holding period". For most people in the world, the question of whether or not to use range names in a financial model is not a very interesting subject. But amongst financial modelers, the issue of when to use range names for data can become a heated debate. Some suggest that every row in a model should have a range name such as revenues, costs and EBITDA. This can be accomplished using the SHIFT, CNTL, F3 short-cut which forces the range names to be documented and allows one to revise the range name. With range names in the spreadsheet, the model formulas are documented (for example, the formula in excel is EBITDA = revenues – costs rather than C5 = C4 – C3.) Further, the use of range names forces all formulas in the sheet to be consistent across columns because if the row name is used in a column (the formula is defined using SHIFT, CNTL, ENTER) then once cannot change the formula definition across a single row. Finally, if the model is structured with range names, one cannot mix up the years by putting the year 2010 in one column in one place in the model and then put another item for 2010 in another column in the model.

While some insist on range names in models, others argue that over use of range names is not helpful because the original source of formulas (e.g. B5 x AB92) is lost (e.g. int_rate x debt_bal). This means that without cell references in formulas, the model may be somewhat more difficult to trace. Further, if a named range is deleted, the model becomes unstable as the formulas can no longer be computed. If one copies a sheet that contains range names to another sheet, the range names do not transfer. Similarly, if one combines files two different files together that each contain the same range name, then excel must decide which range name to use. Finally, using range names can make the model more tedious to program, particularly for the opening balance sheet period in a corporate model and the transaction period in an acquisition model.

While the range name debate is not an exiting subject to most people, a compromise is probably best for most financial models. Some inputs such as the holding period, the plant life or the acquisition price may be useful to name. Further, use of range names is very beneficial, if not essential, when the inputs are used in macros, when inputs are used in forms (combo boxes, spinner boxes and so forth)

Fixed Asset Schedules and Depreciation

Introduction and Simple Assets Schedule

Accurately representing depreciation expense in a model is important because tax depreciation affects actual tax payments; because depreciation expense affects taxes used in computing free cash flow; because depreciation expense is used in terminal value calculations where the ratio of capital expenditure to depreciation expense may be used in computing stable ratios; because depreciation expense affects reported earnings; and because depreciation expense is used it deriving stable EV/EBITDA ratios. When modeling depreciation expense in a corporate model, evaluating the effects of asset retirements on depreciation is a difficult issue. One approach is to multiply the balance of the gross plant by the depreciation rate and increment the gross plant with capital expenditures without accounting for asset retirements. This method overstates depreciation expense and lead to underestimation of taxes and cash flow. Alternatively, one can multiply the net plant by the depreciation rate. This can cause errors because the depreciation rate on net plant is affected by the growth rate of the company and when growth rate changes, the depreciation rate should change.

A separate module is often developed for computing asset balances as well as the book and tax depreciation on an asset. Other assets on the balance sheet that are explicitly considered in a model such as investments, debt issuance cost associated with capitalized underwriting fees and operating reserve accounts can also be included in this section of the model. A separate account can be created for the book balance of assets and the tax balance of assets if there is a difference in depreciation methods or the basis for depreciation.

In its most simple form, the fixed asset schedule for a corporate model, acquisition model or an integrated model begins by defining the closing balance with the book balance from the balance sheet – in an acquisition model this is the pro-forma balance sheet. This should be the gross balance of plant where the gross plant balance is separated from the accumulated depreciation. The reason for separating the gross balance and the accumulated depreciation is so that the depreciation rate can be applied to the appropriate base. Once the closing balance is defined from the balance sheet, the opening balance is of course the prior closing balance. The account then increases with the capital expenditures defined in the working section. With the closing balance of plant defined, the depreciation expense can be defined as the plant balance multiplied by the rate. Use of the opening balance, average balance or closing balance depends on the assumptions made with respect to timing elsewhere in the model. If the cash flows, debt repayments and other items are assumed to occur at the end of the period, then the opening balance should be the base for depreciation expense. If the cash flows are assumed to occur in the middle of the period, then the average balance should be used. Finally, an account should be established for the accumulated depreciation. This account begins with the closing balance from the balance sheet and is incremented with the depreciation expense.

The method described above is often good enough for simple valuation problems where taxes are not a major part of the valuation and the explicit valuation period is fairly short. If the depreciation rate is multiplied by the balance of gross plant, as described above, the progress of the net plant (i.e. gross plant less accumulated depreciation) is correct as capital expenditures are added. However, this simple method results in overstatement of depreciation because retirements of assets reduce both the balance of gross plant and the balance of accumulated depreciation. The overstatement comes about because the gross plant is not reduced by retirements – the gross plant just goes up with the addition of capital expenditures.

In a project finance model, establishing a fixed asset schedule can be relatively simple as well. A couple of differences are that an initial balance sheet is not used to develop the asset schedule; retirements do not bias the results; the tax depreciation is more important than the book depreciation; and, depreciation does not begin until the commencement of operation and the capitalized interest is included in balance of the plant. To address the issues, a gross plant balance account should be established which increases with the construction costs as well as the interest during construction. To begin the depreciation at commencement of operation, the tax depreciation rate (which may vary with the age of the project) is multiplied by the balance of the plant as well as operating switch. As with the non-project finance models, the accumulated depreciation should be computed after the depreciation expense is established.

In modeling a transaction, the total accumulated depreciation or amortization should not exceed the amount that has been spent. To make sure that the depreciation or amortization does is limited, you can use the MIN statement. This involves first computing the accumulated depreciation or amortization and then using the MIN test with the opening balance of the net plant as illustrated below:

Amortization Expense = MIN(Balance x Rate, Opening Balance of Net Plant)

Adjusting the Tax Basis in an Acquisition

For tax purposes, acquisition can be treated as a purchase of assets or a purchase of stock. This tax treatment must be distinguished from the book accounting for an acquisition which results in re-valuation of assets and re-establishing the equity. If the acquisition involves a purchase of assets of assets rather than the purchase of stock, the acquisition price should be more as the asset base will be higher and the value of depreciation deductions increase. In evaluating an acquisition, comparative multiples should account for the difference in value from purchase of stock versus purchase of assets as the multiples should account for the difference in tax rates for different countries. If the acquisition is stock, no write-up for tax purposes occurs, the seller does not pay tax on gain realized from selling asset and the buyer can use the exiting net operating loss. Since the tax depreciation deductions take place over an extended period while the taxable gain must be paid immediately, from the perspective of both the acquiring company and the target company on a combined basis, a stock transaction generally has a positive outcome because the gain on the sale is taxable as current income while the write-up is deducted on a periodic basis. Therefore, on a present value basis, the government treasury wins and the combined shareholders of the two companies lose. In situations with net operating loss, the situation is even worse as the value of the net operating loss carry-forward is lost.

To establish the tax and book depreciation expense in alternative transaction structures, the following steps can facilitate the development of a model:

1. The existing deferred taxes can be used to derive the existing difference between the tax and book base through dividing the accumulated deferred tax by the income tax rate.

   Existing Basis Difference = Accumulated Deferred Tax/Income Tax Rate

2. Given the valuation of the assets, the tax basis increases as the book basis of the assets increases, but the tax basis does not change. The difference in the basis increases the balance of accumulated deferred tax as demonstrated in the formula below.

   Accumulated Deferred Tax after Transaction =
   (New Book Basis – Existing Basis) x Income Tax Rate

3. When computing the goodwill for developing the pro-forma balance sheet, the increase in assets as well as the increase of accumulated deferred tax must be accounted for. In addition to other goodwill adjustments, the goodwill formula should include:

   Goodwill = Goodwill – Increase in Asset Valuation – Increase in Accumulated Deferred Tax

4. For an acquisition, in the fixed asset schedule, the existing assets can be split from the new assets. When modeling the fixed asset schedule, the retirements should be modeled as well as the additions. Retirements should be deducted from both the plant balance and the accumulated depreciation balance. The reason for splitting the assets in this manner is the difference in treatment of asset retirements and the difference in depreciation rates. Existing assets can be depreciated over the remaining life of the assets while the new assets should be depreciated over the various asset lifetimes. Retirements of new assets can be computed using the lifetime of the assets while retirements of existing assets can be modeled with a retirement rate. The modeling of retirements using a retirement rate can be computed using

a simple formula that multiplies the opening balance by the rate while the retirements of new assets can be modeled using the offset command as described below. Some formulas for existing and new assets include:

Existing Gross Assets = Beginning Balance – Retirement Rate x Beginning Balance
New Asset Balance = Beginning Balance + Construction – Retirements
Existing Accumulated Depreciation = Beginning Balance + Depreciation - Retirements
New Asset Accumulated Depreciation = Beginning Balance + Depreciation - Retirements

5. The depreciation on exiting assets should not exceed the balance of net plant. To assure that the depreciation expense does not exceed the net plant, the minimum function can be used as demonstrated in the formulas below:

   Depreciation Expense = Minimum(Plant Balance x Depreciation Rate, Opening Net Plant)

The process of computing depreciation, deferred taxes and cash flow in an acquisition is included in an exercise that is part of the CD and the website. One of the tricky excel techniques in computing the retirements is use of the OFFSET command to develop retirements. This function allows you to go backwards and find the retirements from the capital expenditures. The function works by starting with a cell reference – in this case the current capital expenditure. Then, the cell reference can be moved up or down, forward or backwards through inputting row and column parameters. Through keeping the row the same and putting the negative of the life as the column input, the retirement is the capital expenditure that occurred in the life span of the assets. For example, if the book life is seven and the current capital expenditures are 100 and the capital expenditures eight years ago were 70, then the offset command would use the cell with the 100 as a reference and then go backwards by seven years to find the 70 which is the retirement. There is a problem with this command because before the model reaches the retirement, the OFFSET command will result in an error. This means the OFFSET command can only be used for periods after the life of the asset. To solve this problem, use an IF statement and do not put anything in for the false condition – this will leave a FALSE which is equal to zero.

Illustration of the process is shown in the two figures below. The first figure demonstrates how retirements, net plant and deferred taxes are treated for existing plant. Note that as expected the accumulated deferred taxes related to existing plant should reach a balance of zero.

Existing Assets - Book																				
Opening Balance		5,200.00	4,940.00	4,693.00	4,458.35	4,235.43	4,023.66	3,822.48	3,631.35	3,449.79	3,277.30	3,113.43	2,957.76	2,809.87	2,669.38	2,535.91	2,409.11	2,288.66	2,174.23	2,(
Less: Retirements		260.00	247.00	234.65	222.92	211.77	201.18	191.12	181.57	172.49	163.86	155.67	147.89	140.49	133.47	126.80	120.46	114.43	108.71	1
Closing Balance	5,200.00	4,940.00	4,693.00	4,458.35	4,235.43	4,023.66	3,822.48	3,631.35	3,449.79	3,277.30	3,113.43	2,957.76	2,809.87	2,669.38	2,535.91	2,409.11	2,288.66	2,174.23	2,065.51	1,9
Retirement Rate		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	
Depreciation Rate		13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	
Depreciation Expense		650.00	617.50	586.63	557.29	529.43	502.96	477.81	453.92	431.22	393.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Accumulated Depreciation																				
Opening Balance		0.00	390.00	760.50	1,112.48	1,446.85	1,764.51	2,066.28	2,352.97	2,625.32	2,884.05	3,113.43	2,957.76	2,809.87	2,669.38	2,535.91	2,409.11	2,288.66	2,174.23	2,(
Less: Retirements		260.00	247.00	234.65	222.92	211.77	201.18	191.12	181.57	172.49	163.86	155.67	147.89	140.49	133.47	126.80	120.46	114.43	108.71	1
Add: Depreciation		650.00	617.50	586.63	557.29	529.43	502.96	477.81	453.92	431.22	393.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Closing Balance	0.00	390.00	760.50	1,112.48	1,446.85	1,764.51	2,066.28	2,352.97	2,625.32	2,884.05	3,113.43	2,957.76	2,809.87	2,669.38	2,535.91	2,409.11	2,288.66	2,174.23	2,065.51	1,9
Net Plant	5,200.00	4,550.00	3,932.50	3,345.88	2,788.58	2,259.15	1,756.19	1,278.38	824.47	393.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Existing Assets - Tax																				
Opening Balance		1,750	1,663	1,579	1,500	1,425	1,354	1,286	1,222	1,161	1,103	1,048	995	946	898	853	811	770	732	
Less: Retirements		87.50	83.13	78.97	75.02	71.27	67.71	64.32	61.10	58.05	55.15	52.39	49.77	47.28	44.92	42.67	40.54	38.51	36.59	
Closing Balance	1,750	1,663	1,579	1,500	1,425	1,354	1,286	1,222	1,161	1,103	1,048	995	946	898	853	811	770	732	695	
Retirement Rate		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	
Depreciation Rate		13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	
Tax Depreciation Expense		218.75	207.81	197.42	187.55	178.17	169.26	160.80	30.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Accumulated Depreciation																				
Opening Balance		400.00	531.25	655.94	774.39	886.92	993.83	1,095.38	1,191.86	1,160.99	1,102.94	1,047.79	995.40	945.63	898.35	853.43	810.76	770.22	731.71	6
Less: Retirements		87.50	83.13	78.97	75.02	71.27	67.71	64.32	61.10	58.05	55.15	52.39	49.77	47.28	44.92	42.67	40.54	38.51	36.59	
Add: Depreciation Expense		218.75	207.81	197.42	187.55	178.17	169.26	160.80	30.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Closing Balance	400.00	531.25	655.94	774.39	886.92	993.83	1,095.38	1,191.86	1,160.99	1,102.94	1,047.79	995.40	945.63	898.35	853.43	810.76	770.22	731.71	695.13	6
Net Tax Basis	1,350.00	1,131.25	923.44	726.02	538.46	360.29	191.03	30.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Tax Less Book Depreciation		-431.25	-409.69	-389.20	-369.74	-351.26	-333.69	-317.01	-423.69	-431.22	-393.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Tax Rate		40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	
Change in Deferred Tax - Existing Plant		-172.50	-163.88	-155.68	-147.90	-140.50	-133.48	-126.80	-169.48	-172.49	-157.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Accumulated Deferred Tax - Existing Plant	1,540	1,367.50	1,203.63	1,047.94	900.05	759.54	626.07	499.26	329.79	157.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Modelling the new assets involves the OFFSET command as described above. Note that before the life of the plant has been reached, the result of the retirement row is FALSE. The OFFSET command is modeled using the formula:

Retirements = IF(Period >= Life, OFFSET(Capital Expenditures,0,-Life))

New Assets - Book															
Opening Balance		0.00	103.00	209.09	318.36	430.91	546.84	666.25	789.23	915.91	1,046.39	1,180.78	1,319.20	1,461.78	1,505.63
Add: Capital Expenditures		103.00	106.09	109.27	112.55	115.93	119.41	122.99	126.68	130.48	134.39	138.42	142.58	146.85	151.26
Less: Retirements		FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	0.00	103.00	106.09
Closing Balance	0.00	103.00	209.09	318.36	430.91	546.84	666.25	789.23	915.91	1,046.39	1,180.78	1,319.20	1,461.78	1,505.63	1,550.80
Book Depreciation Rate		8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Book Depreciation		0.00	8.58	17.42	26.53	35.91	45.57	55.52	65.77	76.33	87.20	98.40	109.93	121.81	125.47
New Assets - Tax															
Opening Balance		0.00	103.00	209.09	318.36	430.91	546.84	666.25	789.23	915.91	943.39	971.69	1,000.84	1,030.87	1,061.79
Add: Capital Expenditures		103.00	106.09	109.27	112.55	115.93	119.41	122.99	126.68	130.48	134.39	138.42	142.58	146.85	151.26
Less: Retirements		FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	0.00	103.00	106.09	109.27	112.55	115.93	119.41
Closing Balance	0.00	103.00	209.09	318.36	430.91	546.84	666.25	789.23	915.91	943.39	971.69	1,000.84	1,030.87	1,061.79	1,093.65
Tax Deprecaition Rate		13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%
Tax Depreciation Expense		0.00	12.88	26.14	39.80	53.86	68.36	83.28	98.65	114.49	117.92	121.46	125.11	128.86	132.72
Tax Depreciation Less Book Depreciation		0.00	4.29	8.71	13.27	17.95	22.79	27.76	32.88	38.16	30.72	23.06	15.17	7.04	7.25
Change Deferred Tax - New Depreciation		0.00	1.72	3.48	5.31	7.18	9.11	11.10	13.15	15.27	12.29	9.23	6.07	2.82	2.90

Portfolios of Assets with Vintage Process

Computation of depreciation can be complex when the depreciation rate is not constant for each year. In this situation, the age of the asset must retained to compute depreciation. This can make detailed computation of depreciation one of the most difficult parts of the modeling process. To do this, the following steps can be used:

Step 1: Enter the depreciation rate by year for category.
Step 2: Use the TRANSOPSE function (not the copy and paste special) to set up a matrix that has the year the asset was created on the column and the year of the model on the row
Step 3: Compute the age of the plant and allow the age to be negative in years before the asset was created (use relative references and create a range name such as AGE)
Step 4: Use the HLOOKUP function to relate the depreciation rate to the vintage of the plant
Step 5: Multiply the depreciation rate by the cost of the asset being depreciated from the cost of the asset that was created from the TRANSPOSE function.
Step 6: Repeat the process for assets with different vintages and with book and tax depreciation.

Sumproduct Method

Fix the depreciation schedule
Move the first number

Debt Schedule and Cash Flow Waterfall

Introduction

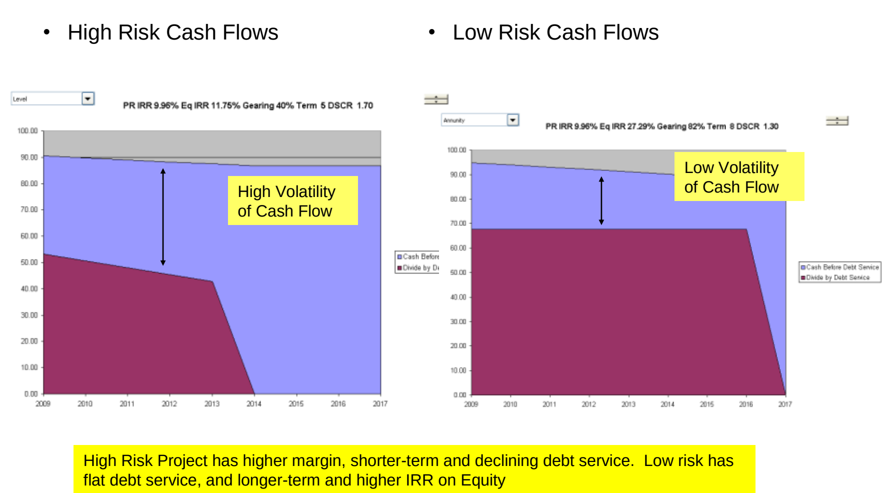
While most time spent in financial modeling should be studying and analyzing value drivers, it is also important to accurately reflect financial structure so the value drivers can be translated into cash flow projections that will measures value and risk. Mechanical issues that translate key assumptions into effective analysis of the risk and value of debt and equity value discussed in much of the remainder of this chapter. This section describes various modeling issues that arise when incorporating debt into a corporate, project finance, acquisition or merger model. The amount of debt that can be issued and

maintained on the balance sheet is central to the general idea of using the risk analysis process of lenders to derive value of an investment which is central to many of the ideas presented in this text. Furthermore, the risk to lenders relative to the earned credit spread is also a critical subject in finance.

Once debt is incorporated into a model, the risk of the debt can be evaluated through constructing a cash flow waterfall. The cash flow to cover debt can be used to test how different levels of debt leverage affect break-even points of operating variables. Alternatively, the models can be used together with Monte Carlo simulation to compute the explicit probability of default and the required credit spread. The mechanics of computing sensitivity analysis, break-even analysis, scenario analysis, tornado diagrams and Monte Carlo simulation analysis is described in the next chapter. The importance of risk analysis together with modeling debt comes together in determining debt capacity. If the cash flow that covers debt is accurately modeled, then one can see if cash flows in a downside case can cover debt. If cash flows cannot cover debt service in a downside case (perhaps with some margin) then the amount and the terms of the debt should change. Before describing the manner in which volatility and judgment can be used in assessing debt capacity, the mechanics of computing various features of debt must addressed.

For each of the four types of models, analyzing details of the structure of the debt can be an essential component of the process of valuing cash received by equity and debt investors. One of the primary uses of corporate models is to assess the credit classification of debt while the project finance models and leveraged buyout models evaluate how specific risks affect the ability to repay debt. Risks of debt and risk classification of debt is crucial to the overall valuation process if one accepts the notion of using debt capacity to evaluate risk using the analysis of lenders whose job it is to evaluate risk, who are from outside of the organization and who have money at risk. Using a model to classify risk could be accomplished with Monte Carlo simulation as described in the next chapter. Alternatively, a more realistic approach is to compute the break-even points of different variables from the perspective of debt repayment. For example, in evaluating an electricity generating plant, one could compute how low the electricity price can fall before the debt defaults. If the electricity price can fall by a wide margin, the loan is less risky than if the electricity price can only fall slightly. Assuming the electricity price is the key item that is subject to uncertainty in the model, if one knew the probability of the electricity price falling below the break-even level, one would also know the probability of default.

Debt Capacity from Cash Flows with Different Volatility



Given the importance of evaluating risks faced by lenders, reflecting the specific features of debt in a model is an essential part of the modeling process. These features include the amount of debt, the repayment structure of the debt, fees paid and spreads on the debt, covenants and required debt service reserves can be principal determinants of whether the transaction will proceed. Depending on the

transaction, the covenants and credit spreads may depend on financial ratios such as the debt service coverage or the debt to EBITDA. Similarly, the nature of debt issued in leveraged buyouts is a key driver of equity returns and the financial viability of the transaction. The structure of debt repayments, new debt issues and the credit spreads is also important in corporate models and merger integration models as the amount of debt issued in a merger can be an important driver of the accretion or dilution in earnings per share. Given the importance of debt in many types of transactions, this section describes various issues associated with structuring the debt schedule in the four model types.

Debt Schedule

The fundamental part of any debt schedule is defining the balance of debt outstanding and computing the interest rate from the balance of the debt. The debt outstanding should be structured by explicitly showing the opening balance, the new debt issues, the debt repayments and the closing balance on separate rows of the model. These debt balance schedules should be listed for every single existing and prospective debt facility that will be present during the forecast horizon. For corporate models, the debt schedule should include all of the debt issues that are outstanding as of the last balance sheet date plus any new issues that may occur over the forecast period. In the case of project finance models, the debt issues include all of the different tranches of debt that are issued to finance construction as well as debt issues for letters of credit, defaults, and debt service reserves. In addition, project finance models may be set up to include debt issues that will in a re-financing. Acquisition models generally include debt issues that are used in financing the acquisition as well as debt that was issued prior to the acquisition and that will be assumed by the new owners. Finally, the debt schedules of an integrated merger model include new debt issued in the transaction as well as debt that will remain outstanding for both the target company and the acquiring company.

The starting point for the debt schedule that establishes the closing balance differs depending on the type of model. When developing corporate models, the closing balance of each debt balance is launched from the financial inputs which should list the amount outstanding in the base balance sheet year for each debt issue. The sum of these individual issues should correspond to the total amount of long-term debt on the balance sheet (including current maturities of short term debt.) If the sum of the closing balance of all of the debt issues does not equal the balance sheet amount, the prospective balance sheet will not balance and there will be an inconsistency in debt maturities and interest expense with actual financial obligations. Therefore, a verification check to assure that the total debt on the balance sheet equals the sum of the individual debt issues can be effective in verifying the model. The process of adding a debt schedule to a corporate model includes the following:

- Set-up the debt schedule with separate lines for:
  - The opening balance
  - Additions from new issues
  - Subtractions from debt repayments
  - The closing balance

- The initial closing balance is derived from inputs that tie to the balance sheet

- After the initial base period which is the last historic period, the subsequent opening balance is equal to the closing balance in the prior period

Once the opening and closing balance are computed the interest cost (whether capitalized or expensed) can be computed. For models that include capitalised interest or a cash flow sweep, it is convenient if not essential to assume that repayments occur at the end of the period which means the opening balance is the basis of accrued interest. If the repayment occurs at the end of the period (say the payments to construction expenditures are made at the end of the month), then no accrued interest on borrowings related to the expenditures. Here, where everything occurs at the end of the period, the accrued interest is computed on the debt that was outstanding before the new debt was issued or repaid in the current period, which implies that the basis of interest expense is the opening balance. Unless the opening

balance is used, hopeless circularity will arise. This idea of using the opening balance is consistent with actual payments of interest and is the primary reason periodic models are used rather than annual models. If the repayment occurs at the beginning of the period, the interest expense is computed on the closing balance. If the repayment occurs somewhere between the beginning and end of the period, the interest is a weighted average of the opening and closing balance.

Modeling Scheduled Debt Repayments

For many models, computing the debt repayment is the most complex element of the modeling process. The manner of repaying debt depends on the type of debt issue and the type of the model. Given the importance and the difficulty in computing debt repayments known as sculpting debt in project finance models, a separate section addresses the issue below. In other models, the repayment calculation can be derived from the opening balance of the debt. For example, in a corporate model where debt issues may be repaid on a single date – bullet repayments – a simple test can be created from the repayment year and this is used to assure that repayment only occurs on the repayment date. Specifically the programming involves:

- Add a line for the repayment of the debt after the opening balance
- Create a formula that compares the model year with the repayment year to create a logical variable (year = repayment year)
- Multiply the (year = repayment year) by the opening balance of the debt

The manner of debt repayment in a project finance model or a leveraged finance model is often tailored to the expected cash flows generated by the investment. For example, a project finance model may have a pre-defined set of repayment percentages that vary over the lifetime of the debt. Because of the percentages are applied to the aggregate amount of debt issued rather than the closing or opening balance it is generally a good idea to show the total accumulated amount of the debt on a separate line item above the debt balance. This accumulated balance can then be multiplied by the repayment percent or a tailored repayment schedule to establish the periodic repayments. Because of early debt repayments that can occur if covenants or cash sweeps are triggered, it is important to make sure that the amounts in the repayment row do not exceed the amount of debt outstanding. To program this, the MIN function can be used to assure that the amount being repaid does not exceed the opening balance of the debt as illustrated below. For leveraged acquisition models and/or integrated merger models, a combination of the corporate finance and the project finance approaches can be applied depending on the type of debt used to finance the acquisition.

MIN(scheduled repayment, opening balance)

Computation of Interest Expense with Credit Spread Grids

The credit spread component of the interest rate can change over time and it can also depend on financial ratios. An example of a grid is shown below.

Spread No	3		***1.5%-1.7% Spread***			
			From Year	2008	2011	2015
			To Year	2011	2015	
DSCR	From	To				
	-	1.20		1.70%	1.90%	2.00%
	1.20	1.50		1.60%	1.70%	1.80%
	1.50	1.80		1.55%	1.65%	1.75%
	1.80	-		1.50%	1.60%	1.70%

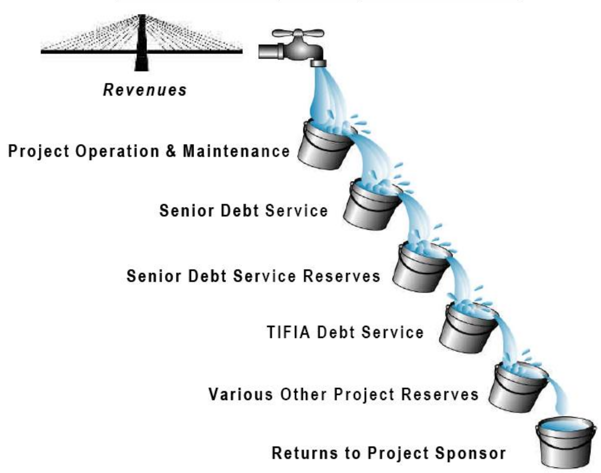
In developing the interest rate, two technical issues arise. The first is finding the rate to apply and the second is working through circularity that can occur. To find the appropriate credit spread, one can use the INDEX command together with the MATCH command. The MATCH command is used to find the row

number and the column number from the table – the row number matches the DSCR and the column number matches the year (you can group and hide the row and column number lines using the hide command – SHIFT then ALT then right arrow.) Once the MATCH is used to find the row and column, the INDEX can be used to find the credit spread. With respect to the circularity problem that occurs because the credit spread drives the cash flow and the cash flow determines the DSCR. To solve this problem one can use the previous year DSCR when evaluating the MATCH function.

Cash Flow Waterfall

Any time debt is issued to finance capital expenditures and other items of a corporation, the uses of funds in a project financing or the purchase of a company, a loan agreement defines various restrictions on uses of cash to pay dividends, subordinated debt and other items. The manner in which a loan agreement establishes priorities in the use of cash flow is sometimes called a cash flow waterfall. The term cash flow waterfall is used to represent the flow of cash to alternative investors and other parties. A cash flow waterfall is somewhat analogous to multiple hydro plants in a cascade where water is held in reservoirs and allowed to flow down-stream by opening or closing various taps. If reservoirs are full, then the water can be allowed to flow down-stream. On the other hand, if reservoirs are empty, there may be requirements to fill-up the reservoir before any water can be used by subsequent hydro plants in the cascade. A cash flow waterfall that defines the priority of uses of cash is illustrated in the diagram below. For project finance models and acquisition models, modelling the mechanics of cashflow waterfalls that include cash flow sweeps, use and repayment of revolving credit facilities, cash trap covenants, top-ups and with-drawls from a debt service reserve accounts, debt defaults and repayment of defaults as well as interest and repayment of subordinated debt can be intimidating to model, much less analyze in a clear and concise manner.

Exhibit 2-B: Example of Project Flow of Funds



In setting up a cash flow waterfall, you can apply a few ideas and make a seemingly complex waterfall easy to program in a financial model. The general ideas include: first setting up the debt schedule (including debt service reserve accounts); second, structuring the cash flow statement with a whole lot of subtotals; third, separately modeling what happens if cash flow is positive versus what happens when cash flow is negative using the MAX function; fourth assuring that you have not exceeded defined limits of debt using the MIN statement relative to the opening balance or the remaining allowed balance. Application of these four steps includes:

- First, set up the debt schedule and reserve balance schedule with opening balances, prepayments from sweeps, uses repayments and availability of revolving credit, required balances, uses and top-ups of debt service reserve accounts and the balance, debt defaults and repayment of defaults for the defaulted debt.

    - For each item such as cash flow sweeps, defaulted debt, repayment of defaulted debt that comes from the cash flow statement, leave the amount in the debt schedule blank. Amounts from the cash flow statement should all be linked to the debt schedule at the end of the process meaning that all of the formulas to determine how much will be removed or placed in an account is taken from the cash flow analysis. For example, the senior debt schedule may be set up using the following account titles where the pre-payments from the cash sweep come from the cash flow statement:

      Opening balance
      Add: Debt Draws
      Add: Capitalised Interest
      Less: Scheduled Debt Repayments
      Less: Pre-payments from Cash Sweep: From Cash Flow Statement
      Closing Balance

    - For accounts such as letters of credit and debt service accounts one should set up accounts that track the remaining balance that can be used or the remaining funding that is required in the account. For a letter of credit, the remaining amount that is available for use is the total commitment less the amount that has already been borrowed. For a debt service reserve account, the amount that must be funded is the total required funding less the amount that is already in the account. Setting-up a letter of credit that can be used to fund deficit cash flow is illustrated below where the borrowings and the repayments come from the cash flow statement:

      Total Debt Commitment
      Less: Amount Already Borrowed (Opening Balance of Loan)
      Remaining Amount to Borrow

      Opening Balance of Loan
      Add: Amount Borrowed: From Cash Flow Statement
      Less: Amount Repaid: From Cash Flow Statement
      Closing Balance

- Second, set up the cash flow account titles and the structure of the cash flow waterfall in the model without entering any formulas.

    - In setting up titles include a whole lot of subtotals in the model design – after virtually every element, such as borrowings and paying back the working capital facility, the debt service reserve flows, the debt defaults and repayment of defaults, the cash flow sweep, and the cash trapped by the covenant. The order of priority in terms of which investor receives cash flows should be set-up in a cash flow analysis. An example of setting-up the cash flow analysis with sub-totals with a debt service reserve account, a letter of credit and defaults and a cash flow sweep is illustrated below (in a real model you would not include as much description):

      Operating Cash Flow
      Less: Interest Expense on Senior Debt
      Less: Repayments of Scheduled Debt

Subtotal 1: Cash Flow after Scheduled Debt Repayment
Add: With Drawls from DSRA if Cash Flow is Negative
Less: Top-ups of DSRA if Cash Flow is Positive
Subtotal 2: Cash Flow after DSRA
Add: Uses of Letter of Credit if Cash Flow is Negative
Less: Repayment of Letter of Credit if Cash Flow is Positive
Subtotal 3: Cash Flow after Letter of Credit
Add: Defaults on Debt if Cash Flow is Negative
Less: Repayments if Cash Flow is Positive
Subtotal 4: Cash Flow after Default
Less: Cash Flow Sweep if Cash Flow is Positive

- In setting up titles for a flip structure, it is useful to set-up some supplemental accounts to establish the subtotals as illustrated below:

Total Cash Flow to Investors
Cash Flow to Senior Investors before Yield Constraint
Less: Cash Flow to Senior Investors before Yield Constraint
Subtotal 1: Cash Flow after Senior Investors before Yield Constraint

Cash Flow with Yield Constraint/Cash Flow to Senior without Constraint
Subtotal 2: Cash Flow to Senior Investors after Yield Constraint
Less: Cash Flow to Senior Investors after Yield Constraint (1-percent) x Total Cash
Subtotal 3: Cash Flow to Junior Investors

- Third, enter formulas for each step of the cash flow waterfall differently depending on whether the cash flow is positive or negative using a combination of the MAX and MIN functions.

  - Use the MAX(cash flow,0) function to test for positive numbers and use the MAX(-cash flow,0) to test negative numbers. For example, if the cash flow after senior debt service is negative, then you should draw from the revolving credit account and use MAX(-number,0) while if it is positive you should use available cash to repay balances and apply the MAX(number,0) function.

- Fourth, in determining how much cash is available or must be used to pay back items, use the MIN function and test the amount against the opening balance.

  - Virtually all of the calculations in the cash flow waterfall will include both a MIN and a MAX function, but this does not mean that the formulas are too complex. For example, when modelling the amount of cash flow that is borrowed from the letter of credit account, the formula should look something like:

    - MIN(opening balance of available to borrow, MAX(-cash flow,0))

  - If cash flow is positive, then the second component of the formula is zero and the minimum of zero or the balance available will be zero. When the cash flow is positive, then the positive cash flow can be used to repay amounts in the working capital facility as shown in the formula below -- if the opening balance is paid off, then the formula will result in zero as it will if the cash flow is negative:

    - MIN(opening balance of revolving debt, MAX(cash flow,0))

  - In modeling a flip structure, use the MIN command to compare the opening balance of the yield tracking account and the cash flow that would accrue to the senior

investors if there was no constraint on the yield. The MIN function combined with the tracking account can be used to find the time at which the yield is realized.

- MIN(Opening balance of tracking account, cash flow)

❖ Fifth, link accounts in the cash flow waterfall to the debt schedule.

- In attaching accounts, the formulas in the debt schedule should be all be simple links, as the evaluations with MAX and MIN formulas have been made in the cash flow analysis. The rule is to keep the formulas in the debt schedule extremely simple.

Dates																				
Start Period		1-Jan-12	1-Feb-12	1-Mar-12	1-Apr-12	1-May-12	1-Jun-12	1-Jul-12	1-Aug-12	1-Sep-12	1-Oct-12	1-Nov-12	1-Dec-12	1-Jan-13	1-Feb-13	1-Mar-13	1-Apr-13	1-May-13	1-Jun-13	1-Jul-13
End Period	31-Dec-11	31-Jan-12	29-Feb-12	31-Mar-12	30-Apr-12	31-May-12	30-Jun-12	31-Jul-12	31-Aug-12	30-Sep-12	31-Oct-12	30-Nov-12	31-Dec-12	31-Jan-13	28-Feb-13	31-Mar-13	30-Apr-13	31-May-13	30-Jun-13	31-Jul-13
Operating																				
Operating		TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Cash Flow for Full Period	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67
Partner 1 - Pre-Flip Percent		85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Partner 1 - Pre-Flip Cash without Flip		14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17
Days		31.00	29.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	31.00	28.00	31.00	30.00	31.00	30.00	31.00
Annual Rate	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Interest Rate for Flip	0.80%	0.81%	0.76%	0.81%	0.79%	0.81%	0.79%	0.81%	0.81%	0.79%	0.81%	0.79%	0.81%	0.81%	0.73%	0.81%	0.79%	0.81%	0.79%	0.81%
Senior - Pre-flip																				
Yield tracking Account																				
Opening Balance		-800.00	-792.34	-784.19	-776.40	-768.34	-760.42	-752.23	-744.18	-736.06	-727.68	-719.43	-710.92	-702.53	-694.07	-685.00	-676.40	-667.55	-658.81	-649.83
Add: Cost of Funds		-6.50	-6.02	-6.37	-6.11	-6.24	-5.98	-6.11	-6.05	-5.79	-5.91	-5.66	-5.78	-5.71	-5.09	-5.57	-5.32	-5.43	-5.18	-5.28
Sub-total		-806.50	-798.36	-790.57	-782.50	-774.58	-766.40	-758.34	-750.23	-741.85	-733.60	-725.09	-716.70	-708.24	-699.17	-690.57	-681.72	-672.98	-663.99	-655.11
Less: Dividends Received		14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17
Closing Balance of Investment Value	-800	-792.34	-784.19	-776.40	-768.34	-760.42	-752.23	-744.18	-736.06	-727.68	-719.43	-710.92	-702.53	-694.07	-685.00	-676.40	-667.55	-658.81	-649.83	-640.94
Percent of Pre-flip Period		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pre-flip Cash Flow	-800	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17
Pre-flip IRR Check	10.00%																			
Senior - Post Flip																				
Total Cash Flow Post Flip		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Post-flip Percentage	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%
Post-flip Cash Flow		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Partner 1 Cash Flow	-800	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17	14.17
Total Partner 2 Cash Flow	-200	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Total Cash Flow	-1,000	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67

Defaults on Debt and IRR on Debt

In using a model to assess an investment with debt financing, a useful task is to determine at what point a loss on the loan occurs. When a loss on debt occurs, the interest rate or the IRR realized by lenders is less than promised interest rate and attempts to restructure the debt have not allowed temporary defaults to be repaid. Modeling the point at which defaults on debt occur is useful in credit analysis because one of the objectives of credit analysis is to measure the probability of default as well as the loss given default relative to the credit spread that compensates for risk. Through explicitly modeling defaults, one can analyze at what point the cash flow is insufficient to repay the debt after restructuring. The IRR earned on debt can be computed in a similar manner to the equity IRR where cash outflows made by equity holders are compared to the dividends received in the pockets of the equity holders. In the case of the debt IRR one can measure the cash flow dispersed to lenders and then the debt service received by lenders. Once the realized IRR on debt is computed through accounting for defaults, the risk of debt can be evaluated through break-even analysis, scenario analysis and Monte Carlo simulation. For example, by incorporating defaults on debt in a model, the break-even level of EBITDA can be computed. The probability of achieving this break-even level of EBITDA can then be used to assess the credit spread of the loan.

The process of incorporating defaults into a financial model involves linking the cash flow statement with the debt schedule using the cash flow waterfall concepts discussed above. The amount of defaults is determined in the cash flow statement using a subtotal account. The amount of default that can be repaid is calculated if there is an opening balance in the default account and if the cash flow after other obligations is positive. The following step by step process can works through how to compute the defaults:

Step1: Set up the a debt balance schedule for the defaulted debt with line items that include the opening balance of defaulted debt, the additions to the defaulted balance from defaults, the repayments of default from positive cash flow and the ending balance of defaulted debt.

Step 2: Compute a sub-total cash flow account after the scheduled debt is paid and after all possible other contingent accounts have been used including the debt service reserve accounts, letters of credit and working capital facilities. Compute the defaults in a row below this sub-total when the amount in the sub-total is negative implying that there is an inability to meet debt service. The amount of the default is limited to the amount of debt service that is assumed to be paid and can be computed using the formula MAX(-cash flow,0) along with a MIN function that limits the default to the total debt service. The following formula represents computation of the defaults on debt:

Default = MIN(debt service, MAX(-cash flow,0)

Step 3: Link the defaults in debt to the defaulted debt schedule. As for other items in the cash flow waterfall such as the debt service reserve account and letters of credit, calculations of cash flow movements should be made in the cash flow statement where they can be directly to subtotals and the only formula in the defaulted debt schedule should be a link.

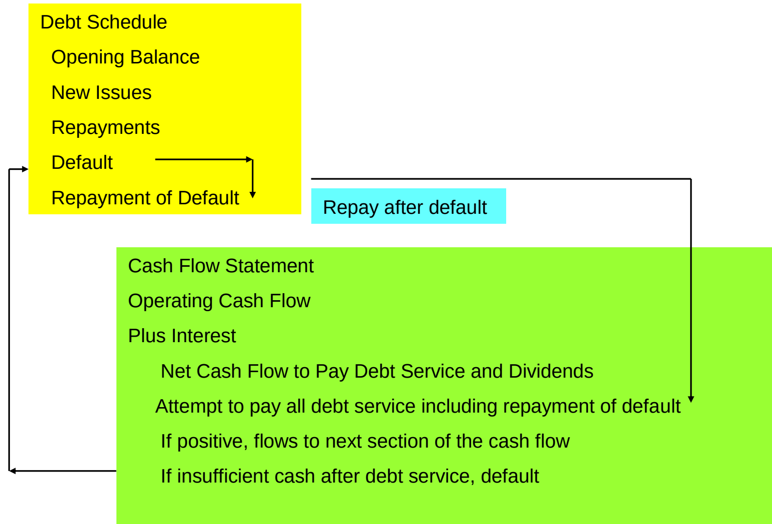
Step 4: Below the debt defaulted row in the cash flow statement, set-up as line for the re-payment of default. The repayment of default is a function of the cash flow and the amount of debt default. Repayment of cash flow only occurs when the cash flow is positive meaning an MAX function should be used. The repayment of default cannot be above the total amount of the defaulted which means it should be capped by the opening balance of the defaulted debt. This means the defaulted debt is the minimum of the positive cash flow or the opening balance of the defaulted debt as shown in the formula below. Once the repayment of the default is computed in the cash flow waterfall using the formula above, link the repayment of default to the debt schedule.

MIN(opening balance of defaulted debt, MAX(cash flow,0))

Step 5: Compute the cash flow realized by lenders for purpose of computing the debt IRR and the debt NPV through deducting defaults and adding re-payment of defaults to the scheduled debt service. The debt cash flow is demonstrated in the following formula:

Debt cash flow = Interest paid + repayments – defaults + repayment of default – cash debt invested

A diagram that is intended to illustrate the link between the cash flow statement and the debt balance is presented below. The diagram below illustrates that the default comes from the cash flow statement, the repayment of default comes from the earlier default, and the repayment of default is put back into the cash flow statement.



Subordinated Debt

The most basic issue in finance is assessing risks and returns from an investment. This issue is highlighted in analysis of subordinated debt where the higher credit spread on subordinated debt must be evaluated relative to the higher risk of subordinated debt relative to senior debt. To evaluate the risk of subordinated debt, a financial model much be able to determine the point at which the loss occurs and the risk and return characteristics of the subordinated debt. In modeling subordinated debt, the first step is to include the debt in the sources and uses analysis. Using the sources and uses analysis, the subordinated debt should be added to the debt schedule. When developing the debt schedule, it is possible that interest is capitalized. To model the interest capitalized, the interest is added to the balance of the debt. In the final period when the subordinated debt matures, the amount of the debt repayment is the sum of the opening debt balance and the interest capitalized for the final year.

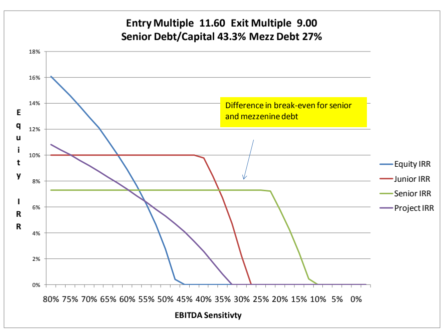
Once the debt schedule is established for subordinated debt, the cash flow statement must reflect the priority of the subordinated debt relative to other debt service. If debt with differing priority is included in the cash flow statement, then a cash flow waterfall should be modeled that reflects the specific provisions including the interest, repayment of debt service, covenants and sweeps of the alternative debt. When structuring the cash flow statement with alternative priorities, it is essential that the ordering of titles in the cash flow analysis conform the ordering of cash flows in the loan documents. For example, if there is a cash flow sweep for senior debt and junior debt interest is not capitalized, then the senior debt sweep must occur after the junior debt interest payments. An example of how junior debt is incorporated in a cash flow waterfall is illustrated below. Notice that there are many sub-total lines.

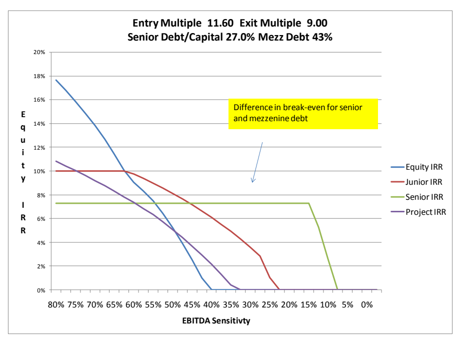
Cash Flow							
EBITDA & Terminal	-	950.00	1,100.00	1,300.00	1,500.00	1,600.00	14,688.00
Less: Senior Interest	-	201.60	168.00	130.45	76.27	4.30	-
Less: Repayment of Senior	-	480.00	480.00	480.00	480.00	61.40	-
Cash after Debt	-	268.40	452.00	689.55	943.73	1,534.30	14,688.00
Add: Defaults on Debt	-	-	-	-	-	-	-
Cash After Default	-	268.40	452.00	689.55	943.73	1,534.30	14,688.00
Less: Repayment of Default		-	-	-	-	-	-
Cash After Default Repayment	-	268.40	452.00	689.55	943.73	1,534.30	14,688.00
Less: Interest Paid on Junior	-	384.00	395.56	395.56	395.56	395.56	281.69
Cash After Interest on Junior	-	(115.60)	56.44	293.99	548.17	1,138.74	14,406.31
Add: Default on Junior Interest	-	115.60	-	-	-	-	-
Cash Flow for Sweep	-	-	56.44	293.99	548.17	1,138.74	14,406.31
Less: Senior Cash Sweep	-	-	56.44	293.99	548.17	-	-
Less: Junior Repayment	-	-	-	-	-	-	2,816.86
Cash after Junior Repayment	-	-	-	-	-	1,138.74	11,589.46
Add: Default on Junior Debt	-	-	-	-	-	-	-
Less: Junior Sweep		-	-	-	-	1,138.74	-
Equity Cash Flow - Dividends	-	-	-	-	-	-	11,589.46
Cash Flow Test	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE

To illustrate how a model can be used to assess the risk of senior versus subordinated debt, a sensitivity analysis can be performed of the EBITDA in terms of senior IRR, subordinated IRR, equity IRR and the overall project IRR. The difference in points at which the senior IRR and the junior IRR crosses is a measure of the risk. In the diagram below the case with more subordinated debt has more risk as demonstrated by the break-even points.

IRR on Senior versus Junior Debt with Different Capital Structures

- More Senior Debt
- More Subordinated Debt





Circularity Created by Interest Expense (Corporate Models)

In many models, a problem of circularity arises because interest expense drives cash flow, but the debt balance or the interest expense is affected by cash flow itself. The most common circularity problem in corporate models comes from the assumption that cash flows and therefore interest expenses occur in the middle of the year. (If monthly or even a daily model is constructed, the circularity would not arise because interest is paid on the opening balance of the debt.) If the assumption of interest expense on the opening balance cannot be applied, then the interest expense affects cash flow, but the cash flow affects the debt balance and interest expense, the interest expense requires iterative calculations. In the real world, bankers do not require interest expense to be paid using a circular formula where they first compute interest expense and then re-compute the interest expense because the debt is increased by interest expense. The problem with circular calculations is that the iterative calculations can cause

models to be unstable. There are various ways to resolve the circular references, but the solutions can be worse than the original problem. The problems can be resolved with macros or the solver function.

The simplest and most common method involves creating a macro using the following steps:

Step 1: Make sure there are two calculations of the thing that is causing the circularity (e.g. interest expense computed in the profit and loss statement and interest expense calculated in the debt schedule).

Step 2: Compute the year by year difference between the two calculations and then sum all of the differences.

Step 3: Record a macro and then copy and paste special as values from one of the rows to the other. For example, in the case of interest expense, copy the interest expense line below the debt schedule and paste it special to the income statement.

Step 4: Modify the macro to include a while and end loop that continues until that sum of the differences equals zero as illustrated below.

```
While Range(“sum_of_difference”) <> 0

    Copy and paste special interest expense from debt schedule to profit and loss statement

Wend
```

Equity Distributions, Flips, Earn Outs and Management Incentives

Shareholders agreements or partnership agreements may define the manner in which senior investors receive a priority on cash flow available after debt in an analogous manner to the way in which loan agreements define priorities on cash flow before equity distributions. Some agreements may distribute dividends using complex formulas rather than simply allocating common dividends in a proportionate all shareholders. These structures can involve a flip where one group of shareholders is allocated the majority of dividends until a given IRR criteria is met. After achieving the IRR target, the dividend distribution scheme changes and the second investor receives a majority of the dividends. Other structures can allocate upside to management or to developers after some criteria is met. For example, management may receive 10% of the excess return over and above an IRR is obtained. Finally in acquisition transactions, earn out provisions can be established whereby a portion of the purchase price is allocated to existing owners, but are allowed to share in upside profits after a certain target is obtained.

The cash flow sharing that is part of shareholder agreements involve some kind of cash flow waterfall applied to equity cash flow. In modeling a cash flow waterfall applied to equity distributions, the formula for receiving the dividends must be understood as is the case for the debt waterfall. If dividends are not distributed in a proportional manner, there must be some kind of trigger mechanism that changes the distribution among investors. Some of the investors receive an implicit priority on cash flow either whether through a shareholder loan or the right to a higher proportion of dividends before some kind of target is met. As with the debt waterfall, the investor that has the highest priority claims on cash flow should be modeled in an analogous manner to the senior debt. Complexity in modeling the cash flows can arise if the criteria is based on an IRR calculation as described above. The problem is that in the period in which the target IRR is obtained. In this period, some of the cash flow is allocated to one investor and some is allocated to a second investor.

First, do the analysis in order with the senior claim to the equity cash flow as the first part of the analysis.

Second, compute an equity tracking account that reaches a level of zero once the IRR target is achieved.

Third, after the first tranche is computed, distribute the income according to percentages.

- ❖ A yield tracking account should be created when modeling a flip structure where a senior investor receives a proportion of cash flows until an IRR yield is met, and a second investor receives the remainder of the cash and a different proportion after the yield is reached. The yield tracking account keeps track of the balance due to the senior after taking account of the earnings that must be realized for the yield to be met. The tracking account is similar to the other accounts except that the opening balance is increased by the yield that must be earned as illustrated below:

Opening Balance
Add: Earnings on Investment (Opening Balance x Required Yield)
Sub-total
Less: Dividends Distributed to Senior Partner
Closing Balance

Dividends distributed is computed as: MIN(-subtotal,dividend formula)

Profit and Loss Statement and Taxes

Once a working module that computes revenues, expenses and working capital is established, as well as the depreciation schedule and the debt schedule, the profit and loss statement should be simple to calculate. The EBTIDA is given by the revenues and cash operating expenses on the income statement. Depreciation and amortization (DA) from the fixed asset module is then subtracted resulting in EBIT. After computing EBIT, interest expense is subtracted and interest income is added resulting in EBT. For project finance and acquisition models, the interest expense and interest income is taken from the debt schedule. For corporate models, the short-term interest expense and the interest income cannot be computed until the short-term debt and surplus cash is computed. With EBT, book taxes are subtracted by multiplying the EBT by the tax rates and subtracting minority interest overall earnings can be computed.

Cash taxes are a somewhat more difficult than deriving book profit, although the calculation is not too painful if taxes are structured properly when setting-up a model. The computation of taxes can have an important effect on capital intensive projects such as renewable energy projects where rapid tax depreciation may be allowed, but the taxable income is not sufficient to use all of the tax deductions (including high levels of interest expense at the beginning of the modeling period.) As with the other mechanical issues regarding construction of a model one of the most important elements is simply not to be afraid to either read or construct the tax section of models. An effective way to compute taxes paid is to add a separate tax schedule that lays out the taxes paid from a net operating loss carryforward analysis. Incorrect computation of taxes paid and simplistic accounting for taxes can cause major problems in measurement of cash flow and valuation.

Computation of Taxes Paid and Taxes Deferred

A modeling process that will model taxes is to first compute the taxes on the books and the cash taxes actually paid. After the income statement is completed, the EBT from the income statement can be used as the first item of cash tax analysis. From the EBT, adjustments can be made that convert the EBT for books into the EBT for taxes. One of these adjustments involves adding back book depreciation and then deducting tax depreciation. Once the adjustments are made, the taxable income for purposes of computing cash taxes can be computed. After the taxable income is derived, adjustments for a net operating loss carry forward can be made. This involves determining the balance of the net operating loss and making adjustments that increase or decrease the carry forward balance. Once the cash taxes

are established, the change in deferred taxes can be calculated along with the accumulated deferred tax. To compute the taxes paid and the taxes deferred, one can following the following step by step process in a module below the income statement.

Step 1: Create a row that repeats the EBT from the income statement.
Step 2: Adjust the book EBT for depreciation and other items that cause cash taxes to differ from the taxes reported on the book profit and loss statement.
Step 3: Set-up and account that maintains the net operating loss balance including the opening balance, the additions that occur when there is negative taxable income and the deductions that occur when the net operating loss is used to reduce taxes that would otherwise be paid when there is taxable income.
Step 4: Compute the amounts deposited into the account from negative taxes through converting the negative amounts into positive numbers.
Step 5: Calculate the amounts removed from the operating loss balance through determining the minimum of the opening balance and taxable income.
Step 6: Compute the adjusted taxable income after adjusting for inflows and outflows from the operating loss account.
Step 7: Multiply the adjusted taxable income by the statutory tax rate to determine the cash taxes.
Step 8: Subtract the book taxes from the cash taxes to determine the change in accumulated deferred taxes.
Step 9: Accumulate the deferred taxes through adding the changes in deferred taxes to the prior years balance. If the accumulated deferred taxes are positive, put the balance on the liability side of the balance sheet and if they are negative, change the sign and put the account on the asset side of the balance sheet.

Complex NOL Calculation

Cash Flow Statement and Balance Sheet

The structure of all of the financial model types includes a cash flow statement and a balance sheet. Complicated issues associated with the cash flow statement were discussed above in the context of the cash flow waterfall. Other than the cash flow waterfall, programming the cash flow statement and the balance sheet simply involves linking the rows with other calculations that have already been made. A separate section is included for these parts of the model in order to be comprehensive and because of the importance of structuring the sheet.

Most of the time it is better to begin a cash flow statement with revenues, expenses and EBITDA rather than net income. If net income is the starting point, then interest expense and interest income are already included in net income. To compute a cash flow waterfall, the senior interest may have to be separated from subordinated interest expense and interest income generally is available for cash flow. Other than the MIN and MAX statements that are used to define the cash flow priorities every item on the cash flow is either a sub-total or directly comes from the debt schedule, the income statement, the working capital module and other places. The end of the cash flow statement is different depending on the type of model. For corporate models and integrated models, the dividends are included in the financing section of the model and the end of the cash flow statement is surplus or deficit cash flow that feeds into the short-term debt and the surplus cash. In the case of project finance models and acquisition models, changes in cash are included as required reserve accounts such as the debt service reserve account and the last line is the dividend distribution.

Other than the model outputs and the risk analysis, the last part of a model is computation of the balance sheet. For people who have done a lot of modeling, seeing the balance sheet balance is a wonderful feeling and the not being able to find where the balance sheet has gone wrong is a nightmare.

Detailed Project Finance Modeling Issues

Introduction

Selected elements of a project finance model are tricky and can cause major headaches for modelers. The worst nightmares in a model often result from circular references that cannot be avoided and make a model less flexible to use in making scenario analysis and in evaluating alternative financial structures. Financial models are often very elegant, detailed and sophisticated in terms of representing a project and they include many sophisticated programs to resolve circular references (such a pressing a picture of a beautiful sculpture for operating a macro that sculpts debt). But if one cannot easily use these sophisticated models to evaluate different debt structures such as debt sizing from the DSCR or varying the debt tenor and draw down provisions, then the model is all but useless. Similarly, if a model contains hundreds of lines of detail about operating expenses, but it cannot be used to easily evaluate how a few of the key variables affect returns and ability to repay debt, then it is not really a good model. Unfortunately, circular references which limit the flexibility and transparency of a model are sometimes unavoidable in a project finance model because of debt sculpting, interest capitalization and funding priorities which makes both the structuring analysis and the risk analysis far more cumbersome. This section deals with how to address items that create inherent circularity. The general philosophy in addressing these difficult issues follows a two pronged approach:

1. See how far one can go in a model using algebraic methods and careful structuring before running into circular reference problems.

2. Address circular reference problems in a transparent and structured manner when they do occur so that structuring and risk analysis can still be performed.

Some people suggest that from a philosophical standpoint that circularity should not occur in the models because it does not occur in real situations. For example, if circularity existed in financing a transaction, the process would work something like the following. The sponsor would go to the bank and ask for a loan commitment. Then, the bank uses the amount of the loan commitment to compute fees. After that, the sponsor asks for a larger loan to cover the fees that were not known before he asked the bank for the loan. With the larger loan, more fees are charged and the sponsor needs an even higher loan. Then the loan is higher and process keeps going on and on and on. The circular reference resembles the film “Groundhog Day” where life cannot move forward. Instead of the scenario with the banker and the sponsor going around, it is more realistic if the sponsor asks for a loan commitment that will already include the fees, the debt service reserve account, and the interest during construction that can cause a circular reference problem. When a company goes to a bank to ask for a loan in a project financing transaction, the company has already created a model and evaluated the sizing of debt, presumably through evaluating the debt service coverage or some other criteria. Notwithstanding philosophical considerations about whether circular references occur in the real world, various combinations of the funding approaches shown in the above table cannot be solved without running into a circular reference problem where the debt or equity commitment drives the total funding needs and when the funding needs drive the financing commitment. From a modeling standpoint, the fees and the loan commitment depend on the financial model, but the model must be computed with some kind of fee and debt commitment assumption. When an item in the model depends on the model itself, a circular reference sometimes cannot be avoided.

Excel has an option to resolve circular references through making iterative calculations which may seem to make the whole circular reference issue not very important. However in a large project finance model, leaving a circular reference in a file using the excel iteration option is very dangerous because the models are large and become very unstable and almost impossible to work with in terms of risk analysis and financial structuring. On the other hand, resolving the circular references with macros can make the models less transparent and flexible as each time an input is changed it is necessary to run a macro and one cannot directly see how calculations are made. To see how the circular reference and other

headaches related to sculpting debt and reserve accounts can be minimized, his section describes various alternative techniques in development of the models. Issues addressed include:

- Capitalized Interest, Fees and Unavoidable Circularity
- Debt Repayments Using Sculpting
- Debt Service Reserve Accounts
- Maintenance Reserve Accounts
- Cash Sweeps and Dividend Restriction Covenants
- Re-financing

Before discussing details of alternative methods in dealing with various circularity and other issues that arise from sculpting, reserve accounts and funding cascades, a summary of items that cannot be resolved without circular references is presented. It is important to carefully consider which issues cause circular references and avoid adding macros to solve circular references without jumping to create VBA programs as soon as a circular reference occurs. The principal items that cause circular references in a project finance model include:

- **Debt Funding and Capitalized Interest:** Determining the amount of debt funding that is required where the total debt commitment is given and interest is capitalised. (The debt funding is the amount of debt that is actually used to pay for cash expenditures rather than being capitalised for interest and fees.) To compute the interest capitalised and the fees, the amount of debt funding that is the basis of these calculations is required. But this amount of funding is not known until the interest and fees are computed. Resolving the circular reference can be accomplished by fixing the amount of total funding (not the total debt commitment) with a macro. It is difficult to come up with an alternative to the circular reference created by this problem. One option is to make evaluate the ratio of the total debt commitment to the debt funding as a function of the length of the construction period, the interest rate, the debt service coverage and other factors.

- **Sculpting, Taxes, and Interest during Construction:** When computing repayments with debt sculpting, the tax effects of depreciation on interest during construction and amortization of fees causes a circular reference that is virtually impossible to avoid. Resolving this problem can be accomplished through fixing the interest during construction and the capitalised fees using a macro. The problem can be dealt with in an alternative manner by keeping the tax effects of interest during construction and fees out of the DSCR calculation and computing the DSCR with and without these tax effects. The target DSCR can be adjusted by a minor amount to account for these items.

- **Interest Income, DSRA and Taxes:** When using debt sculpting to compute debt repayments, the repayments affect the DSRA and the interest on the DSRA affects the amount of sculpting. The problem can be resolved with a macro where the debt service is fixed. Alternatively the problem can be solved with a long algebraic equation.

Risk Analysis versus Structuring Parts of the Model

In addressing the issues of debt sculpting, debt service reserve accounts and maintenance reserve accounts, the notion of separating the model into separate functions that distinguish between structuring the model on the one hand and performing risk analysis on the other hand is important. Most of the difficult problems discussed below address structuring function of a model. The first section below demonstrates that complicated structuring aspects of modeling often cannot be solved without a circular reference, but the circular reference can be limited to a few single items even with complex structuring techniques. The second section demonstrates that if one works hard and is a bit creative, structuring repayments of debt using sculpting can be accomplished without macros that are required in working out the funding portion of the model. The third section demonstrates that even though the debt service

reserve account looks forward to determine required balances, circular references associated with the debt service reserve account can be avoided in virtually all circumstances.

Structuring in a model refers to the process of coming up with the debt and equity amounts and repayments using a particular scenario (for example, the base case.) Issues in structuring include determining the amount of debt from a debt service coverage ratio; computing the required price in a contract from required return and debt parameters; developing the repayment structure of debt from the debt tenor and the debt service coverage; testing different possible structures for a debt service coverage ratio; and, evaluating different funding possibilities such as pro-rata, debt first or an equity bridge loan. When considering multiple structuring options, it can be difficult to easily evaluate different options if macros are used. For example, if a macro button must be pressed every time the debt service coverage ratio is changed, the process can be cumbersome as you have to wait for the macro to clunk along its various iterations before determining how a certain structuring element affects returns. Worse, if the model is used to compute the required contract payment, changing the contract payment requires running a macro, the process can become almost impossible. Given the difficulties in efficiently performing debt structuring where macros are used to resolve circular references, the general approach of the discussion is to go as far as possible without running into a circular reference in order to understand the minimum amount of circular reference calculations that are necessary and to even avoid those.

In contrast to up-front structuring, risk analysis addresses how the transaction works if certain assumptions are varied. For this analysis the amount of debt, the repayment of debt and deposits and scheduled removals from the debt service reserve account are established and fixed. Unless prospective covenants are modeled, there should be no circular reference including potential circularity associated with the use of prospective debt service in a debt service reserve account. Tricky issues in modeling risk analysis involve the cash flow waterfall discussed above and the alternative methods of risk analysis addressed in the next section. Aspects of the waterfall that address structuring mechanics that apply in downside or stress scenarios such as cash flow sweeps, covenants, re-financing, back-up credit facilities and use of debt service reserves should not be part of the initial structuring process.

Capitalised Interest, Fees and (Almost) Unavoidable Circularity

The manner in which a project is funded with senior debt, subordinated debt and equity during the construction period can have important effects on the earned rate of return to equity holders. In some projects with parent guarantees, the equity may not be contributed until the construction on the projects are completed (the loan that finances these type of projects is sometimes called an equity bridge facility). In more traditionally financed projects without parent guarantees, the lenders may insist that equity is contributed before debt to demonstrate that the equity holders have “skin in the game” and to assure that they cannot abandon the project before investing any money. In yet other cases the equity and debt are contributed on a pro-rata basis relative to their commitment based on construction milestones. When financing a project, the interest accrued on a loan is sometimes paid to lenders, which increases funding needs. In other cases the interest is not paid to the lender, but instead is capitalized or rolled-up to increase the size of the loan. As with interest costs, the fees paid to lenders can also either be currently paid or be capitalized. If projects are financed with bonds instead of bank loans, the funding occurs in discrete periods and the amount of money contributed to the project from bondholders is more than is necessary for funding the project in a single year. In this case the amount of funding exceeds the sources of funds and interest income earned on cash balances funds some of the construction expenditures.

Depending on which set of funding techniques described above are applied, the funding schedule can be relatively simple or it can be one of the most difficult problems in the programming of a model. Various different possible combinations of funding structures are illustrated in the table below which include capitalizing or paying interest; bond financing with fully drawn funding in a single period; funding on a pro-rata basis where equity and debt are funded in a proportion of their commitment or funding debt or equity before debt; and, capitalization or current payment of fees. These elements involve the structuring of debt. When performing risk analysis and evaluating issues such as construction cost over-runs and

construction delays, the initial expected funding should be fixed or frozen and terms of the document should be used.

FUNDING STRUCTURE			
Model Mode (1-Structuring; 2 - Risk Analysis)		1	
Structuring Mode	TRUE		
Risk Analysis Mode	FALSE		
Funding Method (1, 2 or 3)		1	
Pro-Rata	TRUE		
Priority: Debt Before Equity, Equity Before Debt	FALSE		
Bond Financing	FALSE		
Pro-Rata Drawdown Percent Approach (1 or 2)		2	
Construction Expenditures Only	FALSE		
Total Fudning Needs	TRUE		
Priority Funding Order (1,2, or 3)			
Senior Debt Last in Priority	FALSE		
Subordinated Debt Last in Priority	TRUE		
Residual Fundng Tranche (1,2, or 3)		1	
Senior Debt	TRUE		
Sub Debt	FALSE		
Equity	FALSE		
Senior Debt Structuring Drivers			
sculpting ratio (DSCR)		1.25	
gearing - debt/equity		85.00%	
annuity switch		FALSE	
Sculpting Method (1 -- forward; 2 -- backward)		1	
Forward NPV Method	TRUE		51,532,994
Backward Method	FALSE		51,532,994

FUNDING ASSUMPTIONS	Cash Funding Input	Funding with Cap Interest	Capitalised Interest	Capitalised Fees	Cash Commit w/o capitalise	Percent of Total w/ Cap	Exceeds Maximum	Date of Funding	Funding Order	Interest Capitalised	Fees Capitalised
Senior Debt	51,532,994	54,273,712	FALSE	FALSE	54,273,712	74.17%	FALSE	31-Aug-11	1	FALSE	FALSE
Sub Debt	7,000,000	7,000,000	FALSE		7,000,000	9.57%		31-Aug-11	3	FALSE	FALSE
Equity	500,000	500,000			500,000	0.68%		31-Aug-11	2		
VAT Facility	11,402,020	11,402,020			11,402,020	15.58%		31-Aug-11		FALSE	FALSE
Total	70,435,013	73,175,731		-	73,175,731	100.00%		61,773,712			

When some of the financing combinations are used (in particular when capitalised interest and fees are not applied and equity is derived after debt is sized) then circular reference can sometimes be avoided through use of algebra or through carefully structuring a model. In other cases, a circular reference arises that cannot be resolved without using some kind of iterative or optimization tool. The most obvious problem occurs from capitalised interest and fees. If the total debt commitment is given ahead of time, one does not know the basis for cash draws without capitalised interest that are required in the model until the model itself is created. For example, assume that the cash flow available for debt service (CFADS) combined with at target DSCR results in an implied total debt size of 500,000. The amount actually borrowed – the funding amount -- to pay for construction will be less than 500,000 because some of the total debt funding must be applied to the capitalised interest part of the loan. If the construction period is more than one period, then there is no simple formula to find the amount that can fund cash construction exclusive of the capitalized interest. Instead, the calculation requires some kind of goal seek function or copy and paste macro that derives the amount of commitment required that together with capitalised interest will result in the total funding. A similar problem arises in the case of financing fees associated with the debt. If interest is capitalised, then the fees cannot be computed until the total interest capitalized is known because fees are computed on the basis of the total commitment, not the commitment without interest. If the total debt funding is made before or after the equity funding, then the amount of equity funding is not known until the interest during construction is established.

In developing a model that has an inherent circularity problem such as the issue with capitalised interest discussed above, it is useful to understand the source of circularity and develop methods to solve the circularity that are as simple as possible. To demonstrate the problem, the discussion below begins with cases where no circularity exists. Next, various structural features that cause circularity are added one item at a time to illustrate why the circularity exists and how to resolve the circularity problem. In creating a model with circular references it is good to find the ultimate source of the circular reference and solve the problem at the source rather than treating a symptom of the problems after you see a lot of blue arrows in excel. Through finding the ultimate source, redundant circular references are not treated and potential alternative methods can be applied. On the other hand, if unnecessary circular references are solved through some kind of macro, goal seek or solver, the process becomes even less transparent and the model is even less flexible. As the reason for the problem in the case of capitalised interest is clear from the discussion above, the cases begin other items.

Case 1: Fixed Debt Commitment, Pro-Rata Funding, Interest Paid

The first case is an illustration of a situation where circular references do not exist. The amount of debt funding is determined in advance and debt draws are made depending on the amount of money that is expended on construction (for example, if one fifth of the total expenditures are made in the first period, one fifth of the debt is drawn). The draw-down percentages are determined from a draw-down schedule where the construction expenditure for the current period is divided by the total construction across all of the whole construction period implying that the draw down percent does not depend on financing. Importantly, the amount of equity funds is computed on a residual basis from the total amount of the debt less the funding needs and the case assumes that there is no interest capitalized, but that interest during the construction period is paid as it is incurred. If a sculpting method is used that does not require a goal seek function (for example, if there are no taxes), the structuring part of the model can be made without any circular reference. The reason there is no circular reference is that the total debt and equity commitment can be determined from the construction expenditures without making any adjustments for interest expense and fees that are paid on the debt. As debt and equity financing commitment is independent of the interest and fee calculations, the process is not circular. As long as the equity is used as the balancing item in computing the funding requirements (i.e. the senior debt and the sub debt are input), then there is no circular reference.

The step by step approach is shown below:

Step 1: Compute cash funding requirements for each period

Step 2: Compute the draw percent that is independent of debt commitment = (Construction_t/Σ Sum)

Step 3: Debt Funding = Fixed debt commitment x draw percent (i.e. independent of funding)

Step 4: Equity Funding = Funding Requirements – Debt Funding

Calculation of the total uses of funds that is the starting point for all of the methods below is illustrated below. Note that the interest during construction and the fees are included as a funding use whether the interest is paid or capitalised. Adjustments for capitalised interest are shown on the sources of funds implying that with capitalised interest, amounts are shown as both a source and a use of funds:

Assumptions	
Construction Period	3
EPC Cost	100,000
Debt Commitment	80,000
Interest Rate	10%
Debt Funded	80,000
Equity Commitment	20,000
Interest Paid	TRUE

Period	-2	-1	0
Uses of Funds			
Construction	33,333.33	33,333.33	33,333.33
Add: Interest Paid	-	2,666.67	5,333.33
Total	33,333.33	36,000.00	38,666.67
Sources of Funds			
Debt	26,666.67	26,666.67	26,666.67
Equity	6,666.67	9,333.33	12,000.00
Total	33,333.33	36,000.00	38,666.67
Debt Schedule			
Opening Balance	-	26,666.67	53,333.33
Add: Debt Draws	26,666.67	26,666.67	26,666.67
Add: Interest Capitalised	-	-	-
Closing Balance	26,666.67	53,333.33	80,000.00
Interest Rate	10%	10%	10%
Interest Recorded	-	2,666.67	5,333.33
Interest Paid	-	2,666.67	5,333.33
Interest Capitalised	-	-	-

Case 2: Fixed Debt Commitment, Pro-Rata Funding, Capitalised Interest

If the total debt commitment is given in advance and interest is capitalised instead of being paid currently, then headaches begin. The total amount of debt that can be used to fund the cash expenditures of project is not known until the interest cost is computed. But the interest is a function of amount of debt issued to fund the project and not the total debt commitment. This causes a circular reference that is illustrated below where it is shown that the debt funding drives the capitalised interest but capitalised interest drives the debt funding because it drives the debt funding.

Debt Funding → Capitalised Interest
Capitalised Interest → Total Debt Commitment
Total Debt Commitment → Debt Funding

In general there are a couple of approaches to resolving the circular reference associated with capitalised interest. The first option is to use the iteration option in excel which sounds very simple but can lead to big problems when you are trying to use the model. The second option is to create a macro that copies and pastes formulas into fixed cells with a simple iteration loop or to create a macro around the goal seek function. These macros can limit both the flexibility and transparency of a model. The third option is to develop an algebraic solution which takes a lot of work and may require you to make a function in excel. The first two options are tantamount to giving up while the third option can be a big challenge requiring a lot of creativity and perseverance. If you can solve the third option then the model can regain its flexibility and users can see where each calculation comes from. While the common copy and paste function is addressed below, much of the discussion in this section focuses on the third option.

One of the key points to resolving the problem of circularity caused by capitalised interest is to thoroughly understand the difference between debt funding and debt commitment. Debt funding is the amount of debt actually borrowed to pay for cash construction and other requirements. The debt commitment on the other hand includes capitalised interest and represents the amount of debt that must ultimately be repaid. Total funding requirements (in contrast to debt funding) includes construction expenditures, development costs and fees, administrative expenses during construction, funding of the debt service reserve account and payment of interest and fees if they are not capitalised. Part of the total funding can come from debt and part can come from equity. The problem is that the amount of funding that comes from debt and equity depends on the debt commitment and that the mix of debt and equity funding depends on the capitalised interest and fees. One can illustrate the mechanics of the problem by defining the funding ratio as the amount of the debt funding divided by the debt commitment. Understanding and calculation

of the funding ratio is central to solving the principal circular reference problem. The following set of equations demonstrates the problem:

Cash Funding Requirements = Capital Expenditures + DSRA Funding + Other Items

Given Debt Commitment = Debt Funded + Capitalised Interest (and Fees)

Equity Funded = Cash Funding Requirements – Debt Funded

Funding Ratio = Debt Funded/Given Debt Commitment

Debt Funded = Funding Ratio x Given Debt Commitment

If the Funding Ratio is known in the above set of equations, then debt funded is a direct function of the debt commitment then the there is no circular reference in the process. If the total funding ratio is computed correctly (either with a copy and paste macro, a goal seek formula or an algebraic formula) then the key test that the process is working is that the given debt commitment that is input (or the result of debt sizing calculations described below). This test – that the computed debt commitment equals the given debt commitment – should be a prominent part of the model verification. The issue with the whole process is that the debt funding ratio must be computed using debt funding. But the debt funding depends on the funding ratio. To resolve this issue one can create a macro or try to compute the funding ratio using algebra. There are many other ways to solve this problem that you will see in financial models. Defining the funding ratio is intended to make the process transparent where you can see the source of the problem.

Computing the funding ratio independent of the debt funding itself can be solved by writing a macro. You can either using the GOAL SEEK function in a macro or by using a copy and paste macro. The copy and paste macro is more common and can be documented using the APPLICATION.STATSBAR function in VBA illustrated below (recall that using range names in important in VBA code). If the circular reference problem occurs only in certain circumstances, a switch variable can be created to test whether it is necessary to run the macro. In setting-up the copy and paste macro, all of the variables such as the fixed funding and the computed funding should be in the same area of the spreadsheet so the process is as transparent as possible. A test variable should be part of the verification page that instructs the user to run the macro when the difference is not zero.

```
    Iteration = 0

    While ABS(Range("Difference_Funding_Needs")) > Range("Precision")

        Iteration = Iteration + 1

        Application.StatusBar = "Running Funding Needs Resolution: Iteration " & Iteration

        Range("Funding_Needs_Fixed") = Range("Funding_Needs_Computed")

        If Iterations > Range("Max_Iterations") Then
            Msgbox "Maximum iterations reached"
            Goto End1:
        End If
    Wend

    End1:
    Application.StatusBar = FALSE            ' re-sets the application bar

End if                        ' test for circular reference problem
```

Solution to two period model where the percent of the draw in the first period is Pct_1

Total Debt Commitment = Debt Funding + Capitalised Interest

Capitalised Interest = Debt Funding_1 x Interest Rate

Capitalised Interest = Total Debt Funding x Pct_1 x Interest Rate

Total Debt Commitment = Debt Funding + Debt Funding x Pct_1 x Interest Rate

Total Debt Commitment = Debt Funding x (1+ Interest Rate x Pct_1)

Debt Funding = Total Debt Commitment/(1+Interest Rate x Pct_1)

Funding Ratio = Debt Funding/Total Commitment = 1/(1+Interest Rate x Pct_1)

Total Debt Commitment = Debt Funding + Capitalised Interest

Capitalised Interest = Debt Funding1 x Interest Rate + Debt Funding2 x Interest Rate

Capitalised Interest = Total Debt Funding x Pct_1 x Interest Rate + Total Debt Funding x Pct_1 x Interest Rate

Total Debt Commitment = Debt Funding + Debt Funding x Pct_1 x Interest Rate
+ (Debt Funding x (Pct_1 + Pct_2) + Debt Funding x Pct_1 x Interest Rate) x Interest Rate

Total Debt Commitment = Debt Funding + Debt Funding x Pct_1 x Interest Rate
+ (Debt Funding x (Pct_1 + Pct_2)) x Interest Rate + Debt Funding x Pct_1 x Interest $Rate^2$

Total Debt Commitment = Debt Funding x (1 + Interest Rate x Pct_1 + (Pct_1 + Pct_2) x Interest Rate + Pct_1 x Interest $Rate^2$

Total Debt Commitment = Debt Funding x (1 + Interest Rate x 2 x Pct_1 + Pct_2 x Interest Rate + Pct_1 x Interest $Rate^2$

Total Debt Commitment = Debt Funding x (1+ Interest Rate x Pct_1)

Debt Funding = Total Debt Commitment/(1+Interest Rate x Pct_1)

Funding Ratio = Debt Funding/Total Commitment = 1/(1+Interest Rate x Pct_1)

Total Debt Commitment = Debt Funding + Debt Funding x Pct_1 x Interest Rate
+ (Debt Funding x (Pct_1 + Pct_2) + Debt Funding x Pct_1 x Interest Rate) x Interest Rate

+ (Debt Funding x (Pct_1 + Pct_2 + Pct_3) + Debt Funding x Pct_1 x Interest Rate +
+ (Debt Funding x (Pct_1 + Pct_2) + Debt Funding x Pct_1 x Interest Rate) x Interest Rate

Total Debt Commitment = Debt Funding x (1 + Interest Rate x 2 x Pct_1 + Pct_2 x Interest Rate + Pct_1 x Interest $Rate^2$

+ ((Pct_1 + Pct_2 + Pct_3) +
+ (1 + Interest Rate x 2 x Pct_1 + Pct_2 x Interest Rate + Pct_1 x Interest $Rate^2$) x Interest Rate

Total Debt Commitment = Debt Funding x (1 + Interest Rate x 2 x Pct_1 + Pct_2 x Interest Rate + Pct_1 x Interest $Rate^2$

+ ((Pct_1 + Pct_2 + Pct_3) +
+ (1 + Interest Rate x 2 x Pct_1 + Pct_2 x Interest Rate + Pct_1 x Interest $Rate^2$) x Interest Rate

Pct_1 x Interest Rate +
+ (Debt Funding x (Pct_1 + Pct_2) + Debt Funding x Pct_1 x Interest Rate) x Interest Rate

One could try and write formulas as above as part of the excel model. This would make the models very cumbersome and difficult to follow. Further, each time you would make a model, you would have to remember all of the painful little details that make a modeler's life so horrible. An alternative is to write a function (analogous to the function discussed above for computing accelerated tax depreciation) to remove the long and tedious formulas. This function requires looping through the construction period and computing both the interest that arises from the funding requirements and the interest that is compounded. Once the function is computed it looks like any other function in excel that may take a long

time to compute by hand (such as the IRR function). The function can later be used in other models and one does not have to go through the burdensome process of re-computing the funding ratio in each model. In developing the functions, it can be a good idea to begin with a relatively simple example and then move to more complex cases unless you are really smart. If there are no fees and if the debt funding is on a pro-rata basis, then the function could have the following form:

```
Function funding_ratio(funding_period_percent, int_rate)

construction_periods = funding_period_percent.Count
ReDim interest(num)
total_interest = 0

For i = 1 To construction_periods - 1

    accum_percent = 0
    prior_interest = 0

    For j = 1 To i Step 1

        accum_percent = accum_percent + pct(j)

        prior_interest = prior_interest + interest(j)

    Next j

    interest(i) = (accum_percent + prior_interest) * int_rate(i)

    total_interest = total_interest + interest(i)

Next i

funding_ratio = 1 / (1 + total_interest)

End Function
```

Case 3: Fixed Debt Commitment, Pro-Rata Funding, Capitalised Up-front Fees

If the total debt commitment is given in advance as in the example above and the fees are capitalised instead of being paid when they are charged, a similar problem arises as with capitalised interest. This section addresses the problem with respect to up-front fees while the next section discusses resolution of the issue for commitment fees. As the total commitment is assumed to be given by debt sizing analysis, the total amount of debt that can be used to fund the cash expenditures of project – the debt commitment minus the fees or the debt funding -- is not known until the fees are computed. But the fees are a function of the total amount of the debt commitment which is not known until the debt funding is computed which depends on the fees themselves. If the fees are paid currently and not capitalised, then there is no problem as long as the interest is also not capitalised. As with the prior example for capitalised interest, a circular diagram can be drawn for capitalised fees.

Total Debt Commitment → Capitalised Fees
Capitalised Fees → Debt Funding
Debt Funding → Total Debt Commitment

To begin the process, assume a simple one period model which is then extended as the case above.

Total Debt Commitment = Debt Funding + Capitalised Fees

Capitalised Fees = Total Debt Commitment x Fee Percent

Total Debt Commitment = Debt Funding + Total Debt Commitment x Fee Percent

Total Debt Commitment - Total Debt Commitment x Fee Percent = Debt Funding

Total Debt Commitment x (1- Fee Percent) = Debt Funding

Funding Ratio = Debt Funding/Total Debt Commitment = (1- Fee Percent)

Case 4: Fixed Debt Commitment, Pro-Rata Funding, Capitalised Commitment Fees

In addition to up-front fees, commitment fees are charged for debt that is committed but not used (from the perspective of the bank, the commitment represents a risky asset and must be compensated for with some kind of credit spread.) As with the up-front fee, a problem arises because the fees change the debt commitment relative to the amount of money that must be borrowed. In this case the total amount of debt that can be used to fund the cash expenditures of project – the debt funding -- is not known until the fees are computed. But the fees are a function of the total amount of the debt commitment which is not known until the debt funding is computed which depends on the fees themselves. If the fees are paid currently and not capitalised, then there is no problem as long as the interest is also not capitalised. As with the prior example for capitalised interest, a circular diagram can be drawn for capitalised fees.

Total Debt Commitment → Capitalised Fees
Capitalised Fees → Debt Funding
Debt Funding → Total Debt Commitment

To begin the process, assume a simple one period model which is then extended as the case above.

Total Debt Commitment = Debt Funding + Capitalised Fees

Capitalised Fees = Total Debt Commitment x Fee Percent

Total Debt Commitment = Debt Funding + Total Debt Commitment x Fee Percent

Total Debt Commitment - Total Debt Commitment x Fee Percent = Debt Funding

Total Debt Commitment x (1- Fee Percent) = Debt Funding

Funding Ratio = Debt Funding/Total Debt Commitment = (1- Fee Percent)

Case 5: Equity Fund up-front

If the sponsor does not provide any guarantee of debt service during construction, then the equity contribution is often required to be funded before the debt funding. In terms of programming, using a circular problem can arise because the interest charged is a function funding, but the funding is a function of interest. Unlike the case above, it is difficult to solve the circular reference when a priority exits with a function and an algebraic equation as above. If the assumption that debt instead of equity is the plug, meaning that the equity funding is fixed ahead of time and the debt funding is derived from the model, then circularity is still not present as long as the interest is paid and not capitalised.

Total Funding Needs = Sum of Construction

Equity Funding = Total Commitment – Interest – Fees

Remaining Equity Commitment = Total Equity Commitment – Opening Equity Balance

Equity Balance = Opening Balance + Equity Funded

Equity Funded = MIN(Remaining Funding, Current Funding Needs)

Debt Funding = Total Funding – Equity Funding

The diagram below illustrates how the circular problem arises when there is a priority for the funding order.

Interest Cost	➔	Funding Needs
Funding Needs	➔	Debt Commitment
Debt Commitment	➔	Interest Cost

This problem can be solved through working backwards. The total debt commitment is known and the total debt commitment grows by the amount of debt funded and/or the interest capitalised and/or the amount of interest expensed.

In this case, the interest during construction is not driven by the amount of debt input, but it is driven by the total funding needs in the model. This structure is not realistic with respect to sizing the senior debt, but it may be the technique used if there is subordinated debt in the structure. As illustrated in the diagram below, when debt is derived instead of equity, the interest cost drives the total amount of funding needs, but the total funding needs drives the amount of debt which in turn drives the interest cost. This change in assumptions creates a circular reference problem because the interest cannot be computed until the debt and the funding requirements are known.

One solution to the above problem is to fix the funding needs as an input and another solution is to fix the amount of the interest cost which is the ultimate source of the problem. If the interest is independent of the funding need, then the debt commitment is also independent of funding and interest no longer depends on the amount of interest itself. Without the fixing the funding requirements, the equations that cause the circular reference problem are:

Total Funding Needs = Construction + Interest Paid
Debt Commitment = Total Funding Needs – Equity Input

Assumptions			
Construction Period	3		
EPC Cost	100,000		
Debt Commitment	80,000		
Interest Rate	10%		
Debt Funded	74,931		
Equity Commitment	25,069		
Interest Paid	FALSE		
Funding Ratio	0.93663912		
Equity Balance			
Total Commitment	25,068.87	25,068.87	25,068.87
Equity Commited	-	25,068.87	25,068.87
Remaining	25,068.87	-	-
Opening Balance	-	25,068.87	25,068.87
Add: Equity Commited	25,068.87	-	-
Closing Balance	25,068.87	25,068.87	25,068.87
Debt Funded	8,264.46	33,333.33	33,333.33

Period	-2	-1	0
Uses of Funds			
Construction	33,333.33	33,333.33	33,333.33
Add: Interest Paid	-	-	-
Total	33,333.33	33,333.33	33,333.33
Sources of Funds			
Debt	8,264.46	33,333.33	33,333.33
Equity	25,068.87	-	-
Total	33,333.33	33,333.33	33,333.33
Debt Schedule			
Opening Balance	-	8,264.46	42,424.24
Add: Debt Draws	8,264.46	33,333.33	33,333.33
Add: Interest Capitalised	-	826.45	4,242.42
Closing Balance	8,264.46	42,424.24	80,000.00
Interest Rate	10%	10%	10%
Interest Recorded	-	826.45	4,242.42
Interest Paid	-	-	-
Interest Capitalised	-	826.45	4,242.42

The circular reference can be solved through fixing the total funding needs and then comparing the computed funding needs with the fixed funding needs. The computed funding needs can be compared with the fixed funding needs to evaluate the accuracy of the fixed funding needs. If difference between the fixed funding needs and the computed funding needs is not zero, then new values of the fixed funding needs can be tried. The whole process can be performed with the debt commitment rather than the

funding needs. Advantages of using the debt commitment occur when sculpting difficulties arise discussed in the next section. Disadvantages of using debt commitment rather than the total funding needs are that the process must be developed for multiple debt tranches if several debt tranches are input.

An illustration of how the process may appear in a spreadsheet is shown below. It is best to reduce the circular reference problems to the minimum as possible because if there are multiple problems then the copy and paste macro may take a lot longer to resolve or it may not fully resolve. Given that one of the main problems with a circular reference in a model is lack of transparency in the resolution techniques, if you can present the circular reference problem and solution in as clear a manner as possible, these problems can be reduced. The table below lists the source of the circular reference and allows fixed values or computed values to be used in the applied funding needs column. The funding needs total in turn drives the amount of the financing commitment and is used as the denominator of the funding percentage calculation.

Resolve

		From:	To:			Circular x	Factors that Can Cause Circular Reference				
Circular References	**Circular Issue**	**Computed**	**Fixed**	**Difference**	**Applied**	**Difference**	**Pro-rata Total**	**Debt Residual**	**Capitalise**	**Debt Last**	Tax and Sculpt
Total Construction	FALSE	57,010,098			57,010,098	-					
Total VAT	FALSE	11,402,020			11,402,020	-					
Total DSRA	FALSE	1,927,895			1,927,895	-					
Total Interest on Senior Debt	TRUE	591,501	591,501	0.00	591,501	0.00	FALSE	TRUE	FALSE	FALSE	FALSE
Total Fees on Senior Debt	TRUE	1,730,511	1,730,511	0.00	1,730,511	0.00	FALSE	TRUE	FALSE	FALSE	FALSE
Total Interest on Sub Debt	TRUE	137,703	137,703	-	137,703	-	FALSE	TRUE	FALSE	FALSE	FALSE
Total Interest on VAT	FALSE	50,548			50,548	-					
Less: Interest Income	FALSE	-			-	-					
Total Funding Needs		72,850,276		0.00	72,850,276						
Subordinated Debt and Sculpting	FALSE	7,000,000	7,000,000	-	7,000,000	-					
Total Difference in Computed versus Fixed Requiring Resolution						0.00					
Macro Required for Resolution of Circularity						FALSE					

Case 4: Fixed Debt, Debt Drawn First, No Capitalised Interest, Equity Residual Tranche

The next set of cases, the total debt or equity commitment is drawn with a priority before another commitment. As discussed above, the priority can have different orders with debt being contributed before equity or equity being contributed before debt. To model alternative priorities, priority can be defined with code numbers (e.g. 1,2,3) and the MATCH and INDEX functions can be used to place a the financial commitments in different orders. The process to place different financing inputs in alternative priorities is illustrated below:

Step 1: Compute Cash Funding Needs (Same as above for the pro-rata methods)

Step 2: Enter number one for the financing that is drawn first

Step 3: Use the MATCH function with the number above and the code number for each security

Step 4: Use the INDEX function to label the financing (e.g. debt or equity) and to acquire the commitment, the date of the commitment, the interest rate, the fee percentages and capitalization switches

Step 5: Develop a table that subtracts cash amounts already drawn from the cash commitment (without capitalised interest) to establish the basis upon which draws are established

Step 6: Compute the balance of the cash funding and use the MIN function comparing the amount available to be drawn relative to the funding requirements

Draws = MIN(available commitment left after prior draws, funding requirements)

Step 7: Compute the funding requirements to the next tranche, through subtracting the draws from the prior funding requirements sub-total

Step 8: Enter the number two and repeat the process.

In this case, there is no circular reference problem as long as the equity is the last trance of debt and the equity is the residual financing tranche. In this case, the debt commitment is computed separately from the interest expense.

Method 2: Priority Funding

Code	1	Security		**Senior Debt**		
Match	1	Cash Funding Commitment		37,103,756		
		Date of Commitment		31-Aug-11		
Total Cash Funding Needs	60,489,627	4,897,113	13,808,929	22,794,692	14,011,816	4,977,077
Commitment Available		TRUE	TRUE	TRUE	TRUE	TRUE
Commitment	37,103,756	37,103,756	37,103,756	37,103,756	37,103,756	37,103,756
Less: Amount Already Drawn		-	4,897,113	18,706,042	37,103,756	37,103,756
Amount Available		37,103,756	32,206,643	18,397,714	-	-
Amount Drawn Senior Debt		4,897,113	13,808,929	18,397,714	-	-
Code	2	Security		Sub Debt		
Match	2	Cash Funding Commitment		7,000,000		
		Date of Commitment		31-Aug-11		
Remaining Funding Needs		-	-	4,396,979	14,011,816	4,977,077
Commitment Available		TRUE	TRUE	TRUE	TRUE	TRUE
Commitment	7,000,000	7,000,000	7,000,000	7,000,000	7,000,000	7,000,000
Less: Amount Already Drawn		-	-	-	4,396,979	7,000,000
Amount Available		7,000,000	7,000,000	7,000,000	2,603,021	-
Amount Drawn Sub Debt		-	-	4,396,979	2,603,021	-
Code	3	Security		Equity		
Match of Code	3	Cash Funding Commitment		16,385,872		
		Date of Commitment		31-Aug-11		
Remaining Funding Needs		-	-	-	11,408,795	4,977,077
Commitment Available		TRUE	TRUE	TRUE	TRUE	TRUE
Commitment	16,385,872	16,385,872	16,385,872	16,385,872	16,385,872	16,385,872
Less: Amount Already Drawn		-	-	-	-	11,408,795
Amount Available		16,385,872	16,385,872	16,385,872	16,385,872	4,977,077
Amount Drawn Equity		-	-	-	11,408,795	4,977,077
Remaining Cash Funding Needs		-	-	-	-	0.00

Case 5: Debt Drawn First, No Capitalised Interest, Debt Residual Tranche

If the debt is the residual funding instead of the equity, then the amount of the total funding depends on the interest expense. The interest expense in turn depends on the amount of the debt commitment that leads to different funding and a different debt commitment. As in the second case above, the circular reference problem can be solved through fixing the total funding needs.

Interest	➔	Funding Needs
Funding Needs	➔	Debt Commitment
Debt Commitment	➔	Interest

Case 6: Debt Drawn Last, No Capitalised Interest, Debt Residual Tranche

If the debt is drawn after equity, then a circular reference arises due to interest and fees during construction. The circular reference does not occur if the equity is the final tranche. The reason for the circular reference is because if the equity is issued before debt, then the amount of equity influences the interest cost. On the other hand, if the equity is issued last, then the amount of interest on debt is only influenced by the fixed amount of the debt issued. The resolution to this circular reference problem is the same as it is for the other problems. If the total amount of funding is independent of the interest then the interest does not depend on the equity issued.

Case 7: Bond Financing, No Capitalised Interest, Equity Residual Tranche

The seventh case involves bond financing where the total amount of financing is assumed to be drawn in one period. In this case, a bond fund account should be established when the bond is issued. Draws from the senior debt are taken from the bond account using a MIN function in an analogous manner to the priority method above. The process begins with the period by period funding needs as in the cases above except that the interest income is used to reduce the amount of funding needs. After the funding needs are listed, the cash account for the bond is listed. The input into the cash account is the bond financing and the use of cash is the smaller of the use of the balance at the start of the period or the funding requirements. After the bond account is used up, the process is the same as in the other situation; the simplest of which is simply funding with equity. Setting-up the funding process with bond issues is demonstrated in the step by step instructions below:

Step 1: Begin with total funding requirements that includes a deduction for interest income

Step 2: Create a switch variable for the time period during when the bond is issued

Step 3: Develop a bond cash account that adds the bond financing using the switch and subtracts the funding

Step 4: The funding from the bond cash account is computed using the MIN function illustrated below:

MIN(total funding requirements, opening balance)

Step 5: Compute the interest income on the bond cash account

Step 6: Compute the remaining funding requirements and use one of the above techniques to compute the funding from other sources

In the bond financing case there is no circular reference unless techniques such as the drawdown percentages that are derived from interest expense are used to separate the remaining subordinated debt (or bank debt) funding and the equity funding.

Method 3: Bond Financing										
Total Financing Requirements Less Interest Income		5,371,289	13,830,363	22,824,195	14,031,513	5,042,161	-	-	-	-
Bond Financing Date	31-Aug-11									
Bond Financing Amount	52,909,617									
Bond Financing Switch		TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Bond Cash Account										
Opening Balance		-	52,909,617	39,079,254	16,255,059	2,223,546	-	-	-	-
Add: Draws from Financing		52,909,617	-	-	-	-	-	-	-	-
Less: Amounts Used for Funding		-	13,830,363	22,824,195	14,031,513	2,223,546	-	-	-	-
Closing Balance		52,909,617	39,079,254	16,255,059	2,223,546	-	-	-	-	-
Annual Interest Income Rate		2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Periodic Interest Income Rate		0.17%	0.17%	0.17%	0.17%	0.17%	0.17%	0.17%	0.17%	0.17%
Interest Income Amount		-	87,385	64,543	26,847	3,672	-	-	-	-
Remaining Funding Needs		5,371,289	-	-	-	2,818,615	-	-	-	-
Sub Debt Percent		93.33%	93.33%	93.33%	93.33%	93.33%	93.33%	93.33%	93.33%	93.33%
Equity Percent		6.67%	6.67%	6.67%	6.67%	6.67%	6.67%	6.67%	6.67%	6.67%
Sub Debt Financing	7,000,000	5,013,203	-	-	-	2,630,707	-	-	-	-
Equity Financing	500,000	358,086	-	-	-	187,908	-	-	-	-
Total	7,500,000									

Case 8: Include Capitalised Interest, Set Total Debt Commitment

If the commitment to fund cash expenditures is defined as an input and the total commitment including capitalised interest is derived from the model, there is no a circular reference problem. In this case the funding component of the model can be solved without a circular reference problem because the capitalised interest is independent of the funding needs. Unfortunately this is not a realistic case because

the total funding needs including the capitalised interest are generally structured as a function of the DSCR or the overall leverage ratio.

The eighth case includes capitalised interest and assumes that the total debt commitment including capitalised interest is defined by some sort of criteria such as the debt service coverage ratio or a leverage ratio. In this case, the capitalised interest causes a circular reference problem because the capitalised interest drives the amount of cash funding, but the cash funding also affects the capitalised interest as shown in the diagram below. The circular reference problem can be solved by entering a fixed value for the total capitalised interest in deriving the cash funding commitment. This circular reference only occurs when interest is capitalised and the fixed amount of capitalised interest should only be used when the capitalised interest switch is TRUE.

Cash Debt Funding = Total Debt Commitment – Capitalised Interest

Capitalised Interest ➔ Cash Debt Funding
Cash Debt Funding ➔ Total Debt Balance
Total Debt Balance ➔ Capitalised Interest

If the circularity related to capitalised interest is resolved, some of the cases that created circularity problems above may not require fixing the funding needs. In cases where the circular reference is created from accrued interest, only the fixed capitalised interest is necessary. The table below summarizes cases that create circular references in the funding part of a model. If the debt commitment is used rather than funding needs, the same item can be used for either the interest paid or the interest capitalised.

	Interest Paid	Int Capitalised
Pro-rata Funding with Construction Expenditures	None	Fix Cap Int
Pro-rata Funding with Total Funding Needs	Funding	Fix Cap Int
Priority with Debt First	None	Fix Cap Int
Priority with Equity First	Funding	Funding and Cap Int
Bond Financing	None	Fix Cap Int
Derive Equity	None	Fix Cap Int
Derive Debt	Funding	Fix Cap Int

The table above demonstrates that there are many situations that create a circular reference when working through funding needs. The bad news is that these must be resolved with careful design. The good news is that other complexities in the model involving debt sculpting and the DSRA can be computed with no circular reference.

Case 3: Fixed Debt, Drawdown Percentages include Interest, Interest Paid

The third case uses drawn-down percentages that include interest expense and the DSRA rather than only the construction expenditure. In the previous two examples, as interest expense increased when the loan was increasing, but this increase in interest expense was not reflected in the drawdown percent. This means the equity funding is relatively high in the early construction periods (when the interest expense is low) and the debt funding is relatively low in the later construction periods when the interest expense is high. To resolve this problem, the drawdown percent can be computed including the interest expense and the DSRA requirement using where the total funding requirements for the period including interest divided by the sum of the funding requirements for the entire construction period.

In this case, draws using the total funding needs rather than only the construction expenditures. This results in pro-rata funding of the debt and equity funding because the draw percentage includes cash interest and the DSRA funding as well as the construction expenditures.

Draw Percent = $(Construction_t + Interest_t + DSRA_t) / \Sigma$ Total Funding

Debt Draws = Draw $Percent_t$ x Total Debt Commitment
$Interest_t$ = Debt Commitment x Interest Rate = (Σ Debt Draws) x Interest Rate

Interest → Debt Commitment
Debt Commitment → Draw Percent
Draw Percent → Interest

To solve this problem, the total funding can be fixed as in the last case which means that the debt commitment and the draws are independent of the interest expense. The total funding can be solved also by fixing the amount of the interest and fees that create the circular reference. If possible, the notion of resolving a circular reference over multiple periods is not recommended. Solving the problem through fixing the total funding and making the debt percent independent is the same as in case 2 above.

Debt Sizing and Debt Sculpting

Sizing the debt and determining the debt repayments are among the most important elements of debt structuring in a model. When structuring debt, one often pre-determines the level of the debt service coverage, the leverage or some other parameter and then backs into the amount of the debt commitment that will make the computed debt service coverage ratio equal the target amount. For example, assume the target minimum debt service coverage to obtain a BBB rating is 1.4 in the base case. Both the debt repayment and the debt size should be consistent with DSCR. If the debt size results in an unreasonable level of debt leverage such as 99%, then the debt size should be constrained.

If the debt repayment is computed on the basis of annuity payments or annuity payments, then a goal seek process can be used to establish the debt size where multiple trials for the debt commitment are input. Alternatively, the debt can be sized by evaluating cash flows in the downside case, in which case the target debt service coverage would be lower. If a level or annuity payment is used, then the DSCR is not constant over the life of the loan. Instead of targeting the minimum DSCR and allowing the remaining coverage ratios to increase, the debt repayments can be varied over time so that the DSCR is the same in each period. The notion of deriving the debt repayments together with the debt size to meet a single target or multiple target DSCR ratios is referred to as sculpting.

Debt sculpting seems to be a difficult process, but there are a variety of different ways to compute debt repayments that make the calculation appear quite simple. Four different techniques are reviewed that demonstrate principle issues in making the calculations. Unfortunately, the simple methods do become difficult when taxes and the DSRA are included in the calculation. The remainder of this section begins by describing the debt sculpting part of structuring a model using artificial case with no taxes and no DSRA account. Four different sculpting methods are described to illustrate the problem. After the simple case, two of the sculpting techniques are discussed in detail in a case with a DSRA account and taxes. As in the prior section, the analysis evaluates how far one can go without running into circular reference problems. After working through the debt sculpting for purposes of debt sizing, techniques to use both sculpting and risk analysis in a model are addressed. At the end of the section, debt sizing in cases with level repayment or with annuity payment is discussed.

Four Sculpting Approaches in Simple Case with no Taxes and DSRA

The complexities of programming a debt structure that results in constant DSCR over the lifetime of debt can be demonstrated in a simple case with no taxes and no DSRA. The first case uses the excel SOLVER to find both the size of the debt and each debt repayment given the pattern of expected cash

flow. The second approach uses a little bit of algebra along with the GOAL SEEK function to size the debt and find the debt repayments. The third method uses the fact that the present value of cash flow at the debt interest rate equals the amount of debt initially issued to size the debt along with the algebra from the prior method. The final method sizes the debt by setting the closing balance at the end of the debt tenor to zero and then backs into the amount of debt that must be issued to result in the zero closing balance.

Method 1: Use of Solver in Sculpting

To illustrate the alternative method, imagine a simple case where the operating cash flow to the project varies over time and that the operating cash flow equals the CFADS. This means that no taxes are subtracted from the CFADS calculation and that interest income is not added to the CFADS. The general objective of the sculpting process is to adjust the debt repayments so that the DSCR will be constant over time given the varying operating cash flow. After setting up a debt schedule with an arbitrary amount of initial debt, one can imagine using multiple GOAL SEEK functions to compute the repayment in each period such that the DSCR equals the target DSCR. In these cases where multiple GOAL SEEK functions are required, you can instead use the SOLVER tool that allows multiple target cells instead of one cell. When running the solver to find the repayments, the process works nicely to find the debt repayment, but the closing balance of the debt does not reach a value of zero unless you happened to enter an amount of initial debt that happens to repay all of the debt. To make sure that the debt is fully repaid, an additional constraint should be entered into the SOLVER that sets the closing balance of the debt to zero. In addition, an additional finding variable should be added that allows the size of the debt issued to change.

The step by step mechanical process for using the SOLVER tool to sculpt is demonstrated below. When entering items in the SOLVER tool, it is not necessary to enter anything into the initial section:

- Add the initial debt issued and an array for the repayment for each period in the CHANGING CELLS section of the solver.

- Add a constraint that the computed debt service ratio equals the target debt service coverage ratio

- Add a constraint that the final debt balance must be zero.

It may be helpful to set-up a macro to re-do the solver with a macro. Unfortunately, this is a bit complex because the visual basic must be adjusted to allow the solver to work. This process involves:

- Step 1: Press the Alt-F11 key to get the visual basic menu
- Step 2: Go to the TOOLS, REFERENCE option and then click on the SOLVER option.
- Step 3: After beginning to record a macro, re-set the solver
- Step 4: Make sure the first part of the solver is not blank
- Step 4: Re-do the solver
- Step 5: Add a Userfinish = FALSE after the SolverSolve

An example of the solver code with the adjusted finish is illustrated below. All of the lines of code except the last line come from simply recording the macro after running the solver.

```
SolverReset
SolverOk SetCell:="$I$5", MaxMinVal:=3, ValueOf:="0", ByChange:="$G$32,$G$46"
SolverAdd CellRef:="$L$2", Relation:=2, FormulaText:="0"
SolverSolve UserFinish = False
```

The solver method is clumsy and performs very slowly in a large model. If you change the tenor of the debt, then you would have to go back to the SOLVER tool and re-enter all of the repayments and the target DSCR arrays. Because of these problems it is doubtful that the method would be used in real

models. However, it is useful to discuss the method because it illustrates the various considerations that must be made in setting the repayments and at the same time sizing the debt. The method demonstrates that one cannot set the repayments to meet cash flow requirements without also sizing the debt. It also illustrates that the one of the objectives of the process is to set the closing balance of the debt at the end of the term of the term.

Method 2: Goal Seek and Algebra

A more elegant solution is to compute the debt repayments using a formula and then size the debt with the simpler single goal seek. The process begins with a re-arranging the basic calculation of the DSCR which is the cash flow divided by the debt service and the debt service is the interest expense plus the debt repayments. In all of the remaining methods, a formula is used to compute the repayment of debt. Using this method, the repayment can be derived as a function of the DSCR and the operating cash flow as illustrated below (note that this formula can only be applied if the interest expense is computed from the opening balance of the debt, implying that cash flows occur at the end of the period):

DSCR = Cash Flow/(Interest + Repayment)

(Repayment + Interest) x DSCR = Cash Flow

Repayment = Cash Flow/DSCR - Interest

When applying the formula above, although the repayment yields the appropriate DSCR, the size of the debt does not mean that the ending balance of debt becomes zero. The method is analogous to the first part of the SOLVER method above before adding the additional constraint to set the closing balance of the debt to zero. To deal with the problem of non-zero debt ending debt, a goal seek formula can be used to determine the leverage percent or the debt commitment in order to set the ending debt balance to zero as illustrated below:

Set Closing Balance to Zero by Changing Initial Debt Issued

It is useful to add a macro to the goal seek so that any time you change an input into the model you can re-size the debt. The only problem with the macro is that the ending debt cell may vary depending on the term of the debt (in many modeling problems, once you open one door to fix a problem, another door appears.) To fix this problem, you can use the SUMPRODUCT function along with a test for the term of the debt as illustrated below:

SUMPRODUCT(Closing debt balance series x (period = term of debt))

The result of this SUMPRODUCT function can then be used in the goal seek with the macro to establish the debt level that works with the sculpting.

While this method is more flexible than the SOLVER method, the approach still requires a GOAL SEEK function and should use a macro. However, application of the method means that some kind of marco must be added to the model and that the GOAL seek tool must be run after changing any input for operating cash flow, the interest rate on debt, the tenor of the debt or the target DSCR.

Method 3: NPV of Debt Service from and Independent Calculation

An elegant way to solve the sculpting problem is to use the formula above for computing debt repayments and then to use the fact that the present value of debt service equals the value of the debt. In this case the goal seek can be avoided and the model can be used to compute debt sculpting without running a macro. The trick in this calculation is that the present value of the debt service must be independent of the debt sculpting calculation. If the debt service from the sculpting analysis is used to compute the value of the debt, then the debt service depends on the initial closing balance of the debt, but the closing balance is the present value of the debt. You end up with a hopeless circular reference. On the other

hand if the simple idea that the debt service is the EBITDA/DSCR is used, the calculation of the debt service is independent of sculpting and present value of the independent debt service yields the closing balance of the debt which is now not dependent on the sculpting calculation.

The idea of having to compute the ending balance using the SUMPRODUCT function and then create a macro around a goal seek reduces the transparency and the flexibility of a model. Instead of using the goal seek, the fact that the initial loan balance is equal to the present value of debt service at the debt interest rate can be used. (If the interest rate is zero, the total amount of the loan is the sum of the debt service. With an interest rate, the loan is reduced do that the interest can be recovered.) Using the NPV formula compute the total amount of debt issued eliminates the need for the GOAL SEEK tool.

When applying the NPV formula or the GOAL SEEK method above, the repayment must only occur in the debt repayment periods. A switch can be created for the debt repayment period and the required debt service can be calculated as the CFADS divided by the target DSCR multiplied by the debt repayment switch. Using this technique, the whole sculpting process can be boiled down to three formulas as illustrated below:

DSCR = CFADS / Debt Service

or,

Required Debt Service = (CFADS / Target DSCR) x Debt Repayment Switch

and,

Total Debt Issued = NPV(Interest Rate, Required Debt Service)

Repayment = Required Debt Service – Interest Expense

This method seems too easy to be true, and it is once income taxes are introduced. In project finance transactions, the credit spread often increases over the term of the debt to encourage re-financing. One theory behind increasing the credit spread is that if the project does well, the loan will be re-financed and the credit spread will never be realized. On the other hand, if the project is not performing well, re-financing will not occur and a higher credit spread should be charged to compensate for the higher project risk. In computing the present value of the loan with changing interest rates, the normal formula for the discount factor – 1/(1+interest rate) ^ period -- does not work. To illustrate the problem, assume an extreme case where the interest rate is 50% in the first year and then it falls to zero in the second year and that the CFADS divided by the DSCR is 100 in each year. In this case, the present value of the cash flow is 75 as illustrated below.

PV of Cash Flow = 100/(1.5) + 100 = 66.67 + 100 = 166.67

If the initial debt balance is 166.7, then the balance of the debt does not fall to zero as illustrated below:

Opening Balance		166.7	140.0
Less: Repayment		16.7	100.0
Closing Balance	166.7	140.0	40.0
Interest Rate		50%	0%
Interest		83.3	0.0

The problem occurs because the value of the second 100 cash flow should be reduced by the 50% interest rate in the first period, as you would have to pay 50% interest in the first year if you want to borrow the 100. Therefore, the total debt balance should be 66.67 times 2 or 133.33. The discount factor can be computed by first calculating an index of the interest rate as one would compute the index for the

inflation rate. After the index is computed, the discount factor is one divided by the index as illustrated below:

$$\text{Index}_t = \text{Index}_{t-1} \times (1 + \text{Rate}_t)$$

$$\text{Discount Factor} = 1/\text{Index}_t$$

When the compound discount factor is used as above, then the discount factor is 1.5 for both years and closing balance of the debt falls correctly to zero.

Opening Balance		133.3	100.0
Less: Repayment		33.3	100.0
Closing Balance	133.3	100.0	0.0
Interest Rate		50%	0%
Interest		66.7	0.0

Method 4: Backward Looking

The whole process of sculpting starts with cash flow generated from a project and works backwards to find debt service and then the amount of debt that a project can support. A fourth method that works backward can be used to compute the debt repayments and the amount of debt issued at the same time is beginning with the closing balance of debt rather than the opening balance of the debt. If one begins with the closing balance instead of the opening balance, then one can work backwards and make the next period opening balance equal to the opening balance. In this case, items after the closing balance do not cause a circular reference while items that are before cause a problem. Through beginning with zero and working backwards, no net present value formula is necessary, but the debt repayment formula is a bit more difficult. Even if you do not use this method, it is instructive to work through the repayment formula for other aspects of a financial model such as the debt service reserve account.

In setting the closing balance, it is convenient to create a switch for the period of the date of the debt tenor of the loan. For the date of the debt tenor, the closing balance is zero. For all of the other periods, the closing balance is equal to the NEXT period opening balance (in contrast to the normal case in which the opening balance is equal to the PRIOR period closing balance:

Closing debt balance = IF(debt tenor, 0, next period opening balance)

Once the closing balance is set, the opening balance is equal to the closing balance plus the repayments (which contrasts with the normal case in which the closing balance is equal to the opening balance minus the repayments.)

Opening debt balance = Closing debt balance + Debt Repayment

The debt repayments cannot be computed as the required debt service less the interest since the interest depends on the opening balance and the opening balance of the debt is a function of the debt repayment. Instead, a bit more algebra can be used to compute the debt repayment. To see how the formula works, calculation of interest expense using the debt repayment rather than the opening balance of the debt should be understood. The interest expense can be computed as function of either the next period interest expense of the closing balance of the debt instead of the opening balance of the debt by recognizing that the opening balance of the debt less the repayments is the closing balance. Alternative interest expense calculations are shown below:

Interest Expense = Repayment x Interest Rate + Next Period Interest Expense

Interest Expense = Repayment x Interest Rate + Closing Balance x Interest Rate

Given the latter definition of interest expense, the repayment can be derived from the debt service and remain be independent of the interest. Since the debt service is given by CADS divided by the target DSCR, no circular reference problem should be present. The repayment can be computed independently of the interest expense is illustrated below. All elements that include repayment are moved to the left hand side of the equation:

Required Debt Service = Interest Expense + Repayment

Repayment = Required Debt Service – Interest Expense

Repayment = Required Debt Service – Repayment x Interest Rate - Closing Balance x Interest Rate

Repayment + Repayment x Interest Rate = Required Debt Service - Closing Balance x Interest Rate

Repayment = (Required Debt Service - Closing Balance x Interest Rate)/(1+Interest Rate)

After working through the equations it is helpful to test whether the computed debt service coverage equals the actual debt service coverage. The usefulness of equations such as this will be demonstrated in the next section where taxes and the debt service reserve account are included in the analysis.

When using this approach, the opening balance of the debt progresses and becomes larger and larger. The opening balance of the debt in the initial period determines the amount of debt that must be issued in the transaction and is the ultimate number that is searched for. The backwards method can solve a few problems with invoking macros relative to the NPV method. However, even if you do not apply the method, it is helpful to think through formulas and why the circular reference arises.

Sculpting Approaches in Complex Cases with Taxes and DSRA

The CFADS is intended to represent cash flow that is available to pay debt service and should reflect the definition of what is available to pay debt service in a loan document for purposes of defining the debt service coverage ratio. Revenues that are collected (after working capital changes) are available for paying debt service, but generally only after operating expense are paid and after provisions for reserves that are input into a maintenance reserve account. Generally, taxes paid are deducted from the revenues and interest income earned on reserve accounts is included in the CFADS. A final item that may or may not be included in the definition of CFADS is the changes in the DSRA account that may provide cash or require cash. Inclusion of taxes, interest income and changes in the DSRA complicate the debt sculpting process and highlight the advantages and disadvantages of the methods discussed above.

If there are no taxes and the interest income rate is so low that it can be ignored, one of the latter two methods above can be used. Advantages and disadvantages of each method. Most Boils down to two methods unless there is net operating loss in the sculpting mode.

Problem 1: Interest Income

CFADS is used to compute sculpted repayments, but the CFADS depends on DSRA income which also depends on debt.

Debt	➔	DSRA
DSRA	➔	Interest Income, DSRA Changes
Interest Income, DSRA Changes	➔	CFADS
CFADS	➔	Debt

Assuming that the debt service reserve account represents one debt service payment (this is the general case with semi-annual modeling and with a six month debt service reserve account), the following formulas can be used to resolve the problem without a circular reference using the third NPV method above. One of the main tricks is to recognize that the opening debt service reserve account is equal to the debt service as illustrated below:

Interest Income = Opening DSRA Balance x Interest Income Rate

Closing Debt Service Reserve Balance = Future Debt Service

Opening Debt Service Reserve Balance = Current Debt Service

Using the fact that the opening balance of the debt service reserve account is the current debt service, the following formula can be derived to compute the debt service that does not depend on the interest income. In the formulas below DS stands for debt service:

DS = (Operating Cash Flow + Interest Income)/Target DSCR

DS = Operating Cash Flow/DSCR + DS x Income Rate/DSCR

DS - DS x Income Rate/DSCR = Operating Cash Flow/DSCR

DS = (Operating Cash Flow/DSCR)/(1-Income Rate/DSCR)

Using this formula, the debt service can be made independent of the interest income and the present value of the debt service can be used to compute the balance of the debt.

Problem 2: Income Taxes without Depreciation on Capitalised Interest

When income taxes are introduced, the problem of sculpting becomes more difficult to solve since income taxes are deducted before computing CFADS. The problem arises because the amount of debt drives the interest expense which in turn drives taxes that affect the CFADS and the taxes themselves. Unfortunately, an equation cannot be used to conveniently solve the problem because interest expense affects taxes but the debt repayment component of debt service does not affect taxes. The problem with taxes and debt sculpting is illustrated below.

Debt	➔	Interest Expense
Interest Expense	➔	Taxes
Taxes	➔	CFADS
CFADS	➔	Debt

If a method other than the backward looking approach is applied, the sculpting method requires fixing the amount of total debt. This can be accomplished with a copy and paste macro using the NPV approach or it can be solved with the GOAL SEEK tool. In most cases, this is a reasonable approach as even if complicated formulas are developed below, circular problems still remain.

If the backwards method is used, an equation can be used to compute repayments that are a function of interest rates and tax rates rather than the interest expense that creates the problem. The process of creating an equation for the debt repayment with taxes is demonstrated below without interest income from the DSRA (which complicates the equations):

DS = (Operating Cash Flow – Taxes)/Target DSCR

DS = Interest + Repayment

Taxes = (Operating Cash Flow – Depreciation – Interest + Interest Income) x T

DS = (Operating Cash Flow – Operating Cash Flow x T + Depreciation x T)/DSCR

DS = (Operating Cash Flow x (1-Tax Rate) + (Depreciation + Interest) x Tax Rate)/DSCR

Interest = Closing Balance x Interest Rate + Repayment x Interest Rate

Putting the equations together and making abbreviations:

- OCF – operating cash flow;
- DP – depreciation expense;
- RATE – Interest Rate;
- RP – repayment;
- CB – closing balance

Using the abbreviations, the formula for debt service above is:

Interest + RP = (OCF x (1-T) + (DP + Interest) x T)/DSCR

Next, substituting the formula for interest expense yields a longer equation:

CB x RATE + RP x RATE + RP = (OCF x (1-T) + (DP + CB x RATE + RP x RATE) x T)/DSCR

Then, moving all items with RP to the left hand side of the equation produces the following equation:

RP x RATE + RP - RP x RATE x T/DSCR = (OCF x (1-T) + (DP + CB x RATE) x T)/DSCR - CB x RATE

RP x (1+RATE – RATE x T/DSCR) = (OCF x (1-T) + (DP + CB x RATE) x T)/DSCR - CB x RATE

RP = [{OCF x (1-T) + (DP + CB x RATE) x T}/DSCR - CB x RATE] / (1+RATE – RATE x T/DSCR)

To apply this equation and keep the formulas reasonable, you can copy this formula to your model. After copying the formula, you can list various lines for the various factors such as the operating cash flow, the tax rate, the depreciation rate and so forth. Then you can separate the formula into various parts. For example, you can split the denominator from the numerator and use an intermediate formula for the CB x RATE. An example of applying the formula through separating factors into different rows is shown below.

RP = [(OCF x (1-T) + (DP + CB x RATE) x T)/DSCR - CB x RATE] / (1+RATE - RATE x T/DSCR)								
Debt Schedule								
Periodic Interest Rate	2.875%	2.875%	2.875%	2.875%	2.875%	2.875%	2.875%	2.875%
Target DSCR	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
Operating Cash Flow	1,756.65	1,775.99	1,834.95	1,844.40	1,915.59	1,924.91	1,998.65	2,007.83
Tax Rate	35%	35%	35%	35%	35%	35%	35%	35%
Depreciation and Amortisation	1,467.11	1,467.11	1,467.11	1,467.11	1,467.11	1,467.11	1,467.11	1,467.11
CB x Rate	1,259.59	1,250.22	1,239.82	1,229.07	1,217.09	1,204.73	1,191.07	1,176.99
Denominator	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Numerator	316.48	332.84	369.31	381.85	425.47	439.13	485.24	500.10
Computed Repayment	309.91	325.93	361.65	373.93	416.64	430.02	475.17	489.73
CFADS	2,099.29	2,108.74	2,143.78	2,146.29	2,188.80	2,190.66	2,234.27	2,235.46
Required Debt Service	1,578.41	1,585.52	1,611.87	1,613.75	1,645.71	1,647.11	1,679.90	1,680.79
Computed Debt Service	1,578.41	1,585.52	1,611.87	1,613.75	1,645.71	1,647.11	1,679.90	1,680.79
Check of Interest	-	-	-	-	-	-	-	-
Check of DSCR	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33

The problem with this method is that depreciation on interest during construction and fees during construction still causes circularity. There are a few solutions to this problem including:

1. Compute the tax effects of fees and the tax effects of IDC depreciation separately from other taxes. Then, you can compute the DSCR with and without the effects of these two items which

are generally very minor relative to other cash flows. The DSCR without tax effects of IDC depreciation and fee amortization is used to compute the debt repayments using the formulas above where the CFADS does not include the tax effects of these items. A spinner box can be used with the where the target DSCR does not include the tax effects of IDC depreciation and fee amortization and then output DSCR with the two items can be shown next to the spinner box. This approach works when interest and fees are not capitalized.

2. Compute the implied debt and then copy and fix the amount. After this, you can use the fixed amount in establishing fees, debt draws during construction and construction expenditures. If this method is used there is less necessity for the backwards method relative to the NPV method. If interest and fees are capitalised, then these amounts must be established with a copy and paste macro anyway.

The method also does not work in cases of expected tax loss carryforward. In these cases a copy and paste macro can be used. An alternative less elegant method is to compute the tax effects of the interest during construction separatelymehtis necessary. Most transactions contain interest capitalized, but the method provides the debt to capital ratio.

Income Taxes with Interest Income

If there is a debt service reserve account with sculpting and no interest income the problem can be resolved without a circular reference. The size of the debt service reserve account is determined after the sculpting calculation is made and the debt service reserve does not affect the sculpting. However, with interest income, the problem becomes complex.

As can be seen from the above equation, the resolution of circular reference problems involve a long formula that can be painful to enter. The good news is that you only have to enter it once and then you do not have to run the GOAL SEEK or copy and paste macro. The bad news is that you have to enter the formula. Further, if there are other items that are tax deductible and other items affect debt service and if there is interest income, then the formula becomes very long. The formula for repayments is demonstrated below.

RP = [(OCF x (1-T)/DSCR + CB x (R x T/DSCR + R x DP x I x (1-T)/DSCR -R) + (OI + OM) x DP x I x (1-T)/DSCR - OI - OP + (OI + SI) x T/DSCR] /
(1+ R - R x T/DSCR - R x DP x I x (1-T)/DSCR - DP x I x (1-T)/DSCR)

In this formula, which can be effective for use in making a model flexible, the following abbreviations are used:

OCF – operating cash flow
T – tax rate
R – interest rate on debt service reserve account
CB – closing balance of debt
DP -- depreciation expense
OI -- other interest expense that is tax deductible

If you are using this formula (and it still has problems because of capitalised interest associated with depreciation expense that is tax deductible), it is best to separate the formula into different parts.

Interest Income = Current Debt Service x Int. Inc. Rate

Interest Income = (Operating Cash + Interest Income) x Int. Inc. Rate/DSCR

Interest Income - Interest Income x Int. Inc. Rate/DSCR = (Operating Cash) x Int. Inc. Rate/DSCR

Interest Income x (1 – Int. Inc. Rate/DSCR) = (Operating Cash) x Int. Inc. Rate/DSCR

Interest Income = ((Operating Cash) x Int. Inc. Rate/DSCR)/(1- Int. Inc. Rate/DSCR)

Problem 3: Depreciation on Interest during Construction and Interest on Subordinated Interest

The formula above still requires adjustments for circular references. The first problem involves interest during construction and taxes. The second problem involves interest on subordinated debt in cases where subordinated debt is the residual financing tranche.

The interest created by interest during construction cannot be resolved by a formula. The source is the interest during construction like in the last section.

Debt	➔	Interest during construction
Interest during construction	➔	Depreciation Expense
Depreciation Expense	➔	Taxes
Taxes	➔	CFADS
CFADS	➔	Debt

This is only in the case where the subordinated debt is the residual tranche in financing.

Senior Debt	➔	Subordinated Debt
Subordinated Debt	➔	Subordinated Debt Interest
Subordinated Debt Interest	➔	Taxes
Taxes	➔	CFADS
CFADS	➔	Senior Debt

If there is a net operating loss, this method does not work. Here must add another circular reference resolution through fixing the total debt and re-trying the sculpting.

Problems with three items: (1) taxes, (2) Income from DSRA, and (3) Movements in DSRA

The last problem is very difficult.

Debt Sizing with Level Re-payments or Annuity Re-payments

If the debt commitment is an input to the model, then the amount of the commitment can be computed using the goal seek of the solver. The goal seek process in excel has a number of problems, including the fact that the inputs are not retained for re-use and the fact that the target must be input as a number and cannot be extracted from an excel reference. A very simple macro can resolve these problems. This involves the following steps:

- Enter the target debt service coverage in a cell in the workbook;
- Turn on the record macro button and then use the goal seek process to set the debt service coverage ratio by changing the debt commitment;
- Modify the recorded macro through using the macro edit button or the ALT, F11 combination of keys;
- When editing the macro, you will see code that defines the goal seek process. To edit the macro, replace the fixed number with the cell reference as illustrated below, where the target debt service coverage ratio is in cell F20;

Before: Range("F14").GoalSeek Goal:=1.5, ChangingCell:=Range("F4")

After: Range("F14").GoalSeek Goal:=Range("F20"), ChangingCell:=Range("F4")

- Replace the cell references with range names in the macro (a practice that should always occur because otherwise the macro will not work when you insert or delete rows);

  Range("C_DSCR").GoalSeek Goal:=Range("Target"), ChangingCell:=Range("Debt")

- Create a spinner box that is linked to the target debt service coverage ratio (you will have use the cell link to an open cell and then divide the cell by 100).

- Attach the macro to the spinner box, through right clicking on the spinner box.

Major Maintenance Reserve Accounts

In project financing and sometimes in other transactions, lenders require cash reserves to be set-up to accumulate money for the prospective payment of major maintenance expenditures. Examples of such expenditures include the overhaul of a wind turbine or the periodic re-surfacing of a toll road. These reserves can cause the rate of return to be a lot lower as the earnings on the cash account should be much less than either the equity return or the interest rate. The developer of a project may complain that he must pay an interest rate of seven percent to borrow money that is put right back into the bank and only earns an interest rate of two percent. At first blush it seems that the modeling of these reserves is not a very complex matter – one can just add a switch for the maintenance period and then assure that enough money is accumulated in the reserve accounts to assure that funds will be available to pay for the maintenance. Unfortunately, there are pesky programming issues with testing for the maintenance period, computing the contributions to the reserve by looking forward to the prospective maintenance period, and adjusting for the final portion of the life of a project after which maintenance will not be required. Programming techniques that are useful for calculating the reserves include establishing a switch for the maintenance period, tracking a period counter for the establishing the remaining periods until the next expenditure, applying the OFFSET function to find the prospective amount of money required for the reserves and using the debt repayment so that contributions do not occur for expenditures after the debt is repaid.

To demonstrate programming issues associated with maintenance reserve accounts, a simple case is presented first where complications of (1) changing maintenance expenditures in future periods; (2) final expenditures in a different period from the final debt payment; and (3) varying time periods between expenditures. In this case the OFFSET function is not necessary and the principal issue involves simply finding the period of the expenditure. The inputs for this case are simply the amount of the expenditure and the time period between expenditures. In this simple case where maintenance occurs on a regular basis and does not change, the step by step process includes:

Step 1: Calculate a switch variable for the maintenance period. To do this, create a switch that uses the MOD function that computes the remainder between two numbers. The MOD function can be used with the variable that measures the age of the project and the maintenance period as illustrated below. When the MOD function is zero and the switch is TRUE, then either the period is a maintenance period. This switch is referred to as the Mod switch in the discussion below.

MOD(period, maintenance period) = 0

In addition to this switch, another switch that does not include the first zero period should be computed. This can be accomplished through multiplying the first switch by the operating period as illustrated below:

Maintenance Switch = Mod switch x Operating Period Switch

Step 2: Compute the spend amount and the contribution to the MRA

Once the switch is computed, the total amount actually spent and the contributions to the MRA can be established. The total amount spent is simply the constant expenditure multiplied by the switch. The contribution is the total amount spent divided by the time periods between the expenditures. This amount should also be multiplied by a debt repayment switch as contributions are not generally required for expenditures that occur after debt repayment.

If the expenditures are not the same in each period -- for example expenditures increase with the rate of inflation -- then the problem of determining MRA contributions becomes a lot more complex. The complexity comes about because of the necessity to look forward to see what to contributions will be. In the period in which the expenditure is made (at the end of the period) a contribution should be made. Beginning in the subsequent period, the contribution to the MRA should reflect the next expenditure. When it is required to look forward or backward from a cell, the OFFSET function is useful. In order to use the OFFSET function, the number of periods until the next expenditure should be counted. For example, if the number of periods between expenditures is ten (five years with semi-annual modeling), then a counter beginning with one and ending with ten should be established. Once the counter is developed, this number should be subtracted from the total time periods between the expenditures yielding the remaining periods until the expenditure. In this way, the remaining periods until the next expenditure should be zero for the period of the expenditure.

The MRA contribution can be adjusted so that no funding is made for expenditures that occur after the debt repayment period. To do this, the amount of the expenditure can be multiplied by the debt repayment switch before the OFFSET function is used. Through adjusting the basis for the OFFSET command by the debt repayment switch, the last expenditure does not have to be in the final debt repayment period. Finally, a test variable can be established to make sure the MRA balance is zero at the end of each spend period. Steps to accomplish the MRA contributions and with-drawls with varying expenditures are shown below:

Step 1: Use the MOD function as above to determine the spend periods

Step 2: Enter the time periods between expenditures as a row in the spreadsheet

Step 3: Use the spend period switch as the basis for computing the number until the next spend. As with the period counter used in computing the age variable, re-set the counter variable one when an expenditure occurs. For the counter to accumulate to the time period between expenditures, the prior period switch rather than the current period expenditure switch should be used as illustrated below.

Counter = IF(prior spend switch, 1, last counter + 1)

Step 4: Compute the periods until the next spend as the total periods between expenditure minus the period counter above. This variable is necessary for the OFFSET function.

Remaining Periods = Total Periods Between Spend - Counter

Step 5: Calculate the total expenditure using an inflation rate through multiplying the total inflated expenditure by the inflation index.

Step 6: Use the debt repayment switch to create a row that records the total expenditure adjusted for the debt repayment that is the basis for contributions to the MRA account and is the basis for the OFFSET function.

Spend Subject to MRA = Spend x Spend Switch x Debt Repayment Switch

Step 7: Use the OFFSET function to compute the required future expenditure. The OFFSET function can be developed by using the adjusted expenditure as the reference cell and then moving to the right by the remaining periods until the next expenditure.

Prospective Expenditure = OFFSET(adjusted expenditure,0,remaining periods)

Step 8: Divide the future required expenditure by the total number of periods between the spends. Use an IF test to assure that a divide by zero does not occur.

MRA Contribution = Prospective Expenditure/Periods Between Spend

Step 9: Compute the MRA balance and then make a test variable to assure that the account goes to zero in the spend period. The formula for this test is illustrated below.

Test = IF(Spend Switch, Closing MRA = 0, TRUE)

The above example did not include varying time periods between expenditures. If the expenditures occur with varying time periods as illustrated below, the problem becomes more complex. Instead of simply entering the time period between expenditures as a fixed variable, the varying time periods must be derived. This variable should be the periods between the expenditures should be the amount from the prior increment in the year of the expenditure. For example, if there are ten periods between commercial operation and the first expenditure but there are five periods between the first and second expenditure, then the time period for the first expenditure should be ten and not five. This can be developed through using the MATCH function using the previous date together with the INDEX function that finds the time period for the next increment.

Date	Expenditure	Periods From Prior
1-May-12		
1-May-17	3,000	10.00
1-May-23	3,500	12.00
1-May-27	3,300	8.00
1-Nov-34	4,200	15.00
1-Nov-39	3,500	10.00
1-May-47	2,000	15.00

Given that the time period between expenditures varies, the MOD function is not relevant. However, the counter between periods and OFFSET function can be used in a similar manner as above. To find the expenditure period, a lookup function can be used with the FALSE switch. When results of the lookup is a number, a spend period is occurring. When the lookup is #N/A then there is no expenditure. Therefore, the ISNUMBER function can be used to make the expenditure switch. Steps of the process that are different from the above process are summarized below.

Step 1: Use the VLOOKUP function (exact match) combined with the start date to find the expenditure for the period. In periods other than the spend period the result is #N/A.
Step 2: Enter the SWITCH variable for the spend (TRUE if a spend period) by using the ISNUMBER function.
Step 3: Match the prior date in the model with the date of the MRA input. The prior date is used because the periods from the prior expenditure should change in the period after the spend switch.
Step 4: Use the index with the MATCH, but begin from the second row and continue for one blank row. This is necessary because the time between periods is the prospective period.
Step 5: Compute the period counter, the remaining period and the prospective spend in the same way as above.

An illustration of the process for computing the maintenance reserve is shown on the table below. The various rows correspond to the discussion above. As with other issues, there is an exercise on the DVD and the website that allows you to work through the formulas yourself.

Period		0	1	2	3	4	5	6	7	8	9	10	11	12
Months in Period		6	6	6	6	6	6	6	6	6	6	6	6	6
Start Date			1-May-12	1-Nov-12	1-May-13	1-Nov-13	1-May-14	1-Nov-14	1-May-15	1-Nov-15	1-May-16	1-Nov-16	1-May-17	1-Nov-17
End Date		30-Apr-12	31-Oct-12	30-Apr-13	31-Oct-13	30-Apr-14	31-Oct-14	30-Apr-15	31-Oct-15	30-Apr-16	31-Oct-16	30-Apr-17	31-Oct-17	30-Apr-18
Operating Period		FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Spend Peiod		TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
Periods Between Spend		6	6	6	6	6	6	6	6	6	6	6	6	6
Period Counter for MRA		1	1	2	3	4	5	6	1	2	3	4	5	6
Remaining Periods until Next Spend		5	5	4	3	2	1	0	5	4	3	2	1	0
Periodic Inflation		0.00%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%
Periodic Inflation Index		1.00	1.02	1.05	1.08	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
Inflated Spend		1,000.00	1,024.70	1,050.00	1,075.93	1,102.50	1,129.73	1,157.63	1,186.21	1,215.51	1,245.52	1,276.28	1,307.80	1,340.10
Spend Amount		0.00	0.00	0.00	0.00	0.00	0.00	1,157.63	0.00	0.00	0.00	0.00	0.00	1,340.10
Debt Repayment Switch		FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Spend Amount Subject to MRA		0.00	0.00	0.00	0.00	0.00	0.00	1,157.63	0.00	0.00	0.00	0.00	0.00	1,340.10
Prospective Spend for MRA Contribution		0.00	1,157.63	1,157.63	1,157.63	1,157.63	1,157.63	1,157.63	1,340.10	1,340.10	1,340.10	1,340.10	1,340.10	1,340.10
MRA Contribution		0.00	192.94	192.94	192.94	192.94	192.94	192.94	223.35	223.35	223.35	223.35	223.35	223.35
MRA Balance														
Opening Balance		0.00	0.00	192.94	385.88	578.81	771.75	964.69	0.00	223.35	446.70	670.05	893.40	1,116.75
Add: MRA Contributions		0.00	192.94	192.94	192.94	192.94	192.94	192.94	223.35	223.35	223.35	223.35	223.35	223.35
Less: Spend		0.00	0.00	0.00	0.00	0.00	0.00	1,157.63	0.00	0.00	0.00	0.00	0.00	1,340.10
Closing Balance		0.00	192.94	385.88	578.81	771.75	964.69	0.00	223.35	446.70	670.05	893.40	1,116.75	0.00
Test		TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Aggregate Test	TRUE													

When the expenditures do not occur in equal periods but are input so as to occur in specific periods and specific amounts, the process is somewhat more complex. In this case rather than using the MOD function discussed above, the MATCH and INDEX functions can be applied.

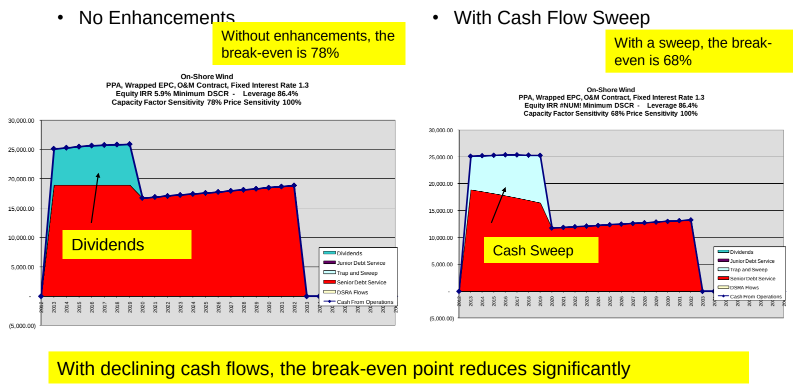
Covenants and Sweeps

In negotiating with lenders, one of the subjects that must be analyzed is the level of covenants and cash flow sweeps. Covenants can range from mandating that equipment is in good working order to strict limitations on payment of dividends. For modeling purposes, it is the latter type of negative financial covenants that should be incorporated in a model. These covenants can affect returns to equity investors because they affect the timing of cash flows that are allowable to be paid out as dividends. The covenants can take the form of cash flow traps that limit dividends when times are bad (and there is not much cash flow available for dividends anyway.) Alternatively, the covenants can be in the form of cash flow sweeps which limit the cash flow that limits the cash than that can be distributed when times are good.

Covenants do not change the operating cash flow of an investment and can only change the timing of who receives the money and in what order. With more restrictive covenants, the equity holders must wait while without the covenants, the equity holders can receive cash flows earlier. The timing of equity cash flows can have relatively large effects on the equity IRR and assuring that cash flows accrue to lenders before equity holders can reduce the risk to holders of debt.

A financial model should be able to assess the tradeoff between risk and return of covenants and cash sweeps. For example, the model can be used to assess how much the operating income can decrease with and without a covenant to evaluate the effectiveness of the covenant. If the covenant allows the operating to decline by a wide margin more than the operating income can decline without the covenant, than the covenant is effective in reducing risk. The efficacy of the covenant depends on the structure of the cash flow. If cash flow is increasing over time, the covenant will not be effective in reducing risk. If the cash flow "falls off a cliff" after a few years, the sweep and covenants can be effective. A summary of the analysis of covenants and sweeps is illustrated below.

Effect of Cash Sweep With Declining Cash Flows



The mechanics of modeling covenants are analogous to calculating defaults as described above. In particular, the debt schedule is tied to the cash flow statement. In the case of covenants, the cash that is not allowed to be paid in dividends can be either used to pay of debt earlier than scheduled or alternatively, it can be placed in a cash reserve account depending on the language of loan agreements. If cash is used to pre-pay debt, the cash that is trapped should be included in a line item in the debt schedule. If the cash is applied to a reserve account, a separate account should be set-up the debt module of the model. The step by step process below describes how to incorporate a cash trap or a cash sweep covenant into a model.

Step 1: In the cash flow statement, add sub-total rows that show the cash flow that is available for a cash sweep or a cash covenant.

Step 2: Include a test in the model that evaluates how much of the cash that is available for the cash sweep or cash trap will be unavailable to pay dividends or other subordinated debt. This may be a test against the debt service coverage ratio in the case of a cash trap covenant or a test against a debt to EBITDA ratio in the case of a cash sweep covenant in a leveraged buyout.

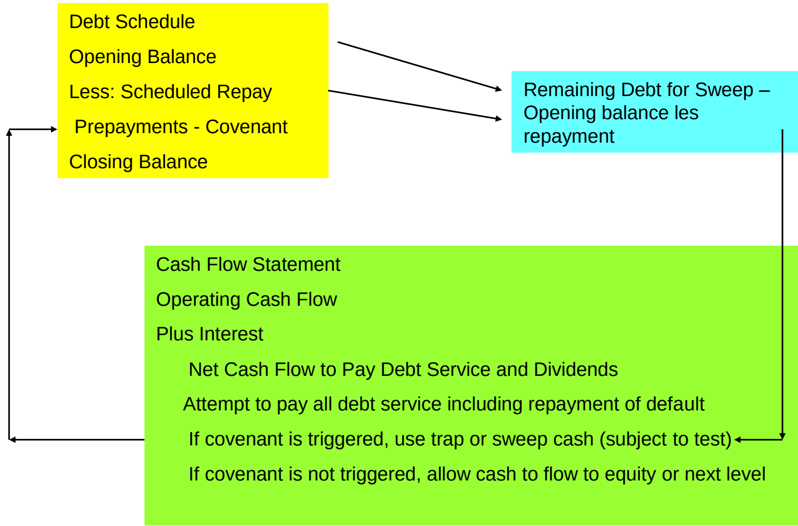
Step 3: Use a covenant test to determine the amount of cash trapped or swept in the cash flow statement. The test could be whether the DSCR is below the covenant in the case of a cash trap, or it could be a multiplication of a cash sweep percentage.

Step 4: In the cash flow statement where a line item lists the cash flow sweep or cash flow trapped, the line item should include a minimum function to assure the most cash that is trapped is the amount of debt outstanding.

Step 5: The cash flow that is trapped or swept must be applied to something. One option is to use the cash to pre-pay debt and the second is to build-up cash in a reserve fund. If cash is used to pay down debt, then as long as the minimum function is used in the repayment analysis, then the debt will appropriately be paid earlier. If the reserve account is used, then an item must be added that releases cash from the reserve when the covenant is met or the debt is repaid.

The diagram below illustrates how process for covenants or cash flow sweeps works in terms of linking the cash flow statement to the debt schedule. (Note that if the cash flow from the cash sweep or the cash trap is applied to a reserve account, the proceeds are used as cash inflows into the cash reserve.) The intermediate box in the diagram demonstrates that evaluation must be included somewhere in the model to assure that the cash flow sweeps are not pre-paying more debt than is outstanding – if all of the debt is paid, there is no longer a reason to sweep any cash. If a cash sweep or a covenant is implemented, then the cash that is prevented from paying dividends can either be used to pre-pay debt or put into a reserve account. For debt holders, prepaying debt is more favorable from a credit perspective because it permanently reduces debt while money in a reserve account can be used to pay dividends before debt is

repaid. Mechanically, the programming of sweeps and covenants is similar to modeling of defaults in terms of connecting the debt schedule to the cash flow statement. Structuring provisions on debt such as cash lock-ups and sweeps limit distributions to equity in different ways. Discussion of the reason for covenants and sweeps in alternative transactions. How much they really protect the debt holder and harm the debt holder. The effect in alternative transactions – project finance and leveraged buyouts. Modeling issues.



As with the discussion above, to avoid circularity, use the prior year debt service coverage ratio. When developing the model use the prior. If the terms require forward DSCR or current DSCR, then compute a fixed line and use a circularity resolution method.

Debt Service Reserve Accounts

The major point about this is not about complicated programming and development of macros that are often included in the analysis. Rather, you can work through a couple of equations and you should think about how the DSRA really works. The DSRA seems to create a very difficult circularity problem because the required DSRA balance depends on next year's debt service, but the next year debt service depends on the cash flow, which is in turn dependent on DSRA account:

Debt Service Reserve	→	Next Period Debt Service
Next Period Debt Service	→	This Period Cash Flow (Due to Sweeps, Debt Defaults etc.)
Cash Flow	→	Debt Service Reserve flows

This problem can be eliminated by thinking about the formula for next period's debt service. The current level of interest is the beginning balance of the debt multiplied by the interest rate. In the next period, the interest expense declines as the debt is repaid. This means that the next period interest can be defined as the opening balance of the debt less the repayments multiplied by the interest rate.

Current period Interest = Opening Debt Balance x Interest Rate

Next Year Interest = Closing Debt Balance x Interest Rate (Next Period)

Next Year Interest = (Opening Debt Balance – Repayment) x Interest Rate

The last equation above is the crucial calculation for the debt service reserve calculations. If the debt repayment does not depend on the cash flow, which should be the case because the debt service reserve calculation does not depend on the estimating cash flow, then the next year interest does not depend on the cash flow. Further, the debt repayment should be fixed in advance.

Problem of finding the next period debt service semi-annual in monthly model when using more than one period.

Next Period Interest = (Opening Balance of Debt – Fixed Repayment) x Next Period Interest Rate

Record the Interest in the next period for check in structuring mode. Do not use in calculation.

Remove Cash Sweep

Set-up switches for the last period of construction

Project finance transactions and some leveraged buyout transactions include requirements to put cash aside in a bank account to assure that there is a buffer to meet prospective debt service requirements. A typical requirement is that the next semi-annual debt service must be held in an account and must be always available. Such an account assures that temporary blips in cash flow will not cause a default and assure that if something bad happens and the debt needs to be restructured, that time is available for restructuring. For owners, the problem with locking up cash in this manner is that holding cash on the balance sheet and earning a return much lower than the overall equity return can be very expensive in terms of the rate of return on equity. For example, if a project borrows money at a rate of 7% to fund the DSRA and then puts the borrowed money right back into the bank, it may receive interest income at a much lower rate, say 1.5%. This low income rate relative to the interest expense rate can have a big negative effect on the equity IRR, particularly in the case of projects with tight coverage. An alternative to holding a debt service reserve account is to commit to a letter of credit. In this case a commitment fee must be paid, but the project does not experience the cost of borrowing money at a high rate and earning a much lower rate.

Issues associated with the debt service reserve account that can cause major headaches in modeling. These headaches are caused by the fact that the DSRA reserve account depends on the next period debt service and if there is a cash sweep, then the interest expense depends on the cash flow after adjustments to the DSRA. Other problems with the DSRA account arise because sculpting of debt is driven by CFADS which in turn depends on the taxes and interest income. Since interest income and taxes depend on debt service, the sculpting requires working through some algebra to resolve the problems. A final problem with is very difficult to resolve is the issue of including movements in the DSRA in the CFADS when sculpting debt. This can only be resolved by using a backwards method in sculpting debt.

Debt service reserve accounts can present tricky modeling issues from a technical standpoint because the debt service is computed on a prospective basis. Since the debt service reserve cash flows depend on the next period debt service and the next period cash debt service may depend on debt service reserve cash flow, a difficult circularity problem can arise. Other mechanical issues include: (1) computing changes in the debt service reserve account that arise from changes in debt service; (2) calculating uses of the debt service reserve account when there is deficit cash flow; (3) building-up the debt service reserve account from cash flow in a project; (4) withdrawing amounts from the debt service reserve account when debt matures; (5) adding amounts to the debt service reserve that arise from a cash flow sweep; and (6) transferring amounts from reserve built up during the construction period.

The fundamental manner to resolve this difficult issue is to compute a fixed level of debt service requirements after debt sizing routines have been developed. As part of the debt sizing routine (which is normally a macro) a routine that resolves circularity associated with the debt service reserve account

should be included. If resolution of the circularity is included in the debt sizing routine, then the routine only has to run when the debt is sized and not when scenario and sensitivity analysis is performed. For example, the following steps can be used:

1. Develop a macro that computes sets the closing balance of debt to zero using a debt sculpting formula. The macro simply incorporates a goal seek routine that sizes the debt by setting the closing balance to zero.

2. Once the sculpted debt repayments have been computed, copy and paste the computed amounts to another line (copy and paste special). It is important to compute the fixed amounts because you do not want to re-compute the sculpted debt repayments when performing sensitivity or scenario analysis.

3. Use the fixed debt service rather than the computed debt service in the debt service reserve analysis. This will avoid the circularity associated with the debt service reserve account where the amount of funds required in the debt service reserve account depend on the next period debt service, but the next period debt service depends on the debt service reserve account.

4. After computing the debt service reserve account, the cash flow will change and the fixed debt service will no longer produce a zero balance in the ending debt account or the target debt service coverage ratio will no longer equal the realized debt service ratio. In addition, the fixed debt service will no longer equal the computed debt service. To resolve this problem create an iteration routine where goal seek in step 1 and the copy and paste in step 2 are repeated until the difference between the fixed and computed debt service is zero.

In general, a debt service account should be modeled in an analogous manner to debt issues with an opening balance, additions and subtractions, a closing balance and interest income (instead of interest expense). A technique that simplifies modeling of debt service reserves is to first establish the required amount that should be in the debt service reserve. Since the DSRA balance should equal the required balance, the net inflows to the account (a negative amount on the cash flow statement) can be established where by the inflows are the opening balance less the required balance. Computing the net amount in this manner is a short-cut method and one could separately show the various components including removal of the closing balance and initial funding amounts. As with the discussion of cash flow sweeps discussed above, the amount of withdrawn from the debt service reserve or added to the debt service reserve comes from the cash flow waterfall. Steps to compute the debt service reserve account are described below:

Step 1: Compute the amount of the required debt service reserve from the next period fixed debt service as described above.

Step 2: Set-up the balance of the debt service reserve by including a line item for net inflows into the account to derive the required balance and a line item to withdraw from the debt service reserve account to meet cash flow short-falls.

Step 3: The difference between the required debt service reserve account and the opening balance of the debt service reserve account is the amount that must be funded or that is available for cash flow. This amount is the basis for evaluating whether funding is available. The potential for funding the DSRA depends on the amount of cash flow.

Step 4: In the sources and uses statement, include the amount required to be funded in the DSRA by multiplying the required funding by the construction phase switch. Do not use the amount of funding from the cash flow statement in the sources and uses statement – this will create a circular reference.

Step 5: Include a line item in the cash flow statement for net inflows into debt service reserve (note that this amount can be negative when amounts are withdrawn because the required balance declines and/or falls to zero at the end of the debt life.) Compute a sub-total line in the cash flow statement as the cash flow before debt service reserve account flows. If this amount is positive, then the DSRA can be funded (or amounts can be withdrawn) up to the amount that is required as illustrated below:

MIN(MAX(cash flow for DSRA,0), Required DSRA Funding)

Step 6: Include a subtotal line after the payment of debt service to reflect the potential for negative cash flows that arise. Once the negative cash flows are computed, evaluate whether the amount can be met from the reserve balance. The formula is shown below:

MIN(opening balance of DSRA, MAX(-cash flow,0))

Free Cash Flow in Project Finance Models

To consider the adjustments for debt in the computation of free cash flow, first think about the case where debt exists but there are no income taxes. In this situation, three adjustments are necessary to obtain free cash flow from equity cash flow: (1) adding debt financing and interest during construction for the construction phase, (2) adding interest expense over the operating life of the project, and (3) adding debt repayments during the operational period. During the construction period, free cash flow can be computed using either of the following two formulas (where interest during construction is the amount of interest paid to lenders, but recorded as a capital expenditure rather than an expense). The first formula begins with analysis of capital expenditures:

Free Cash Flow = -(Capital Expenditures - Interest During Construction)

In the operating period (after the commercial operation date) free cash flows can be calculated from the cash flow statement through adding back debt service – interest expense and principal payments -- to dividend payments shown on the financial statements. Alternatively, free cash flow can be computed from the income statement and the operating portion of the cash flow statement as the amount of revenues less expenses less working capital change :

Free Cash Flow = Earnings before Depreciation, Interest and Taxes less Working Capital Change

Computing the free cash flow from equity cash flow when income taxes exist and debt is present is somewhat more complex because interest expense is deductible for tax purposes and because interest during construction affects tax depreciation deductions. The value of the interest deductions must be included in the value. This is accomplished through lowering the WACC rather than increasing the cash flow when applying the standard DCF model. The reduction of the WACC is computed through using an after tax discount rate for the debt component rather than a pre-tax interest rate (i.e. interest rate x (1 – tax rate).) If interest expense is added back to equity cash flow in computing free cash flow, the resulting number will be higher than the cash flow would have been had there been no debt at all because taxes are lower with the presence of debt. Therefore, when adding interest expense back to equity cash flow, an adjustment is required to account for the fact that income taxes are lower than they would have been without the existence of interest deductions from debt. Making this interest tax shield adjustment -- computing the tax effect of interest expense -- can be accomplished through subtracting an interest tax shield from free cash flow as shown in the formula below (an additional adjustment for the tax shield created from depreciation on interest during construction is required in project financing transactions):

Free Cash Flow = Cash Flow before Financing + Interest Expense – Interest Expense x tax rate – Depreciation Expense on Interest during Construction x tax rate

Free cash flow can also be computed from earnings before interest taxes and depreciation. This formula that directly begins with operating income is more intuitive but also involves more adjustments.

Free Cash Flow = EBITDA – EBIT x Tax Rate – Capital Expenditure – Working Capital Change + Depreciation Expense on Interest during Construction x Tax Rate

Appendix 1:
Real Estate Modelling Issues

Real estate analysis and modeling is somewhere between corporate finance and project finance. Analysis of a hotel project or a commercial building may be closely related to project finance modeling as the project moves through different stages and the financing may be driven by the cash flows. On the other hand, the projects have less of a defined life and are often valued at some arbitrary terminal date as is in corporate analysis. Other real estate projects such as residential and commercial mixed development projects are more like corporate models where a portfolio of projects with different cash flow patterns and risks is financed and the residual values at some terminal date is evaluated. However the individual components of the mixed development projects are evaluated much like project finance. The structure of real estate projects affects the type of ratios used to evaluate the credit quality and the equity value of the projects. Because of the indefinite life and the ability to sell projects, the loan to value ratio is used in lieu of the DSCR in project finance. However, the debt to capital ratio from accounting statements is not as relevant as it is for traditional corporate analysis. Unlike corporate analysis where the net present value of free cash flow is used to evaluate investments, real estate projects rely on the IRR realized by different investors as in project or structured finance.

Given that real estate falls somewhere in-between corporate finance and project finance, many issues associated with real estate and financial institution models are covered in describing the four general model categories above. For example, consider a the real estate analysis nt where properties are held for a few years and then are assumed to be sold at multiples(called cap rates). This type of analysis has many characteristics of a project finance model where the construction period and the operation period must be distinguished. It also includes elements of corporate modeling where flexible holding periods and terminal period analysis plays an important role.

However there are some unique issues associated with the models including structuring portfolios of real estate projects in which each project has different start dates and programming maintenance of adequate capital ratios for bank models. This appendix assumes that you have reviewed the sections that address project finance models related to setting-up project phases and time periods and describes some features of a real estate model that are different from a project finance model. Differences in a real estate model include:

- In modelling a single project such as a multi-family development or a hotel, the sale of a project after a given holding period is often modeled and the features of debt are different from typical project finance models.

- In modeling developments that include a portfolio of different projects, cash flow is generated before construction of all of the projects is completed. This means that a separate sources and uses analysis is not a good way to structure models.

- In modelling real estate projects, there are often multiple different units and buildings which are completed at different times. To consolidate projects with different start and end dates, separate project by project can be established using a common master time line for all projects. The switch variables are then all adjusted to the common master time line.

- In modelling commercial real estate investments, the analysis should include the effects of different lease terms with alternative expiry dates. Modeling idle time and lease renewals can result in long and non-transparent formulas.

- Some real estate projects have multiple participating tranches with different return targets and sharing mtechanisms

Modelling a Single Project

An effect way to understand a real estate project is first to model a single project and then later to put projects together in a portfolio described below in the section on mixed development. Modelling a single project is very similar to modeling project finance with the exception that a holding period is defined after which the project is sold. Operating inputs that drive the value of the project include the occupancy rate that varies with the life of the project, the rental rates which can be volatile, occupancy rates that are correlated with the rental rates and fixed and variable operating expenses. In selling the project a time period switch can be established for the terminal period. To define the sale price, a capitalization rate is generally used. The capitalization rate is the value of similar projects that are bought and sold in a market divided by the pre-tax cash flows. For example if a project is sold for 10,000 and its rental revenues net of operating expenses are 500, the capitalization rate is 500 divided by 10,000 or 5%.

Rather than using the total project life to measure the operating period as in other project finance models, the operating period is generally defined by the holding period before which the project is sold. Then, similar to the acquisition model described above, the project is sold after the holding period. This can be accomplished through dividing the cash flow by the cap rate which is a percentage and also by a terminal value switch (the terminal value switch is simply a TRUE/FALSE logical variable that is defined with the formula = (period = holding period). The theory behind the cap rate is very similar to the ideas underlying computing the terminal value using the final year cash flow divided by the cost of capital minus the growth rate. The cap rate reflects both the cost of capital and growth rate. For example if one believes the growth rate in rents is 2.5% in a market and the cap rate is 5%, then the implied cost of capital is 7.5% (cap rate = (WACC – g) which means that WACC = cap rate + g). With a higher growth rate the cap rate should be lower and if the cash flows are less risky (for example, if there are fixed leases) then the cap rate is also lower.

Once the proceeds from selling an asset are computed (net of fees and other transaction costs) a couple of accounting and tax issues arise. For tax purposes a capital gain is generally computed as the sales proceeds less the net book value of the fixed assets. The capital gain is the sales proceeds less the Once the rate of return in a real estate model is computed – the equity and project return Real estate debt can take many forms as with project finance debt, but when the project is sold at the end of the holding period, the debt must be retired. In addition, when the project is sold, the fees and taxes on the gain on sale should be accounted for.

Cash Flow Generated Before Completion of Construction

In some real estate projects, projects are held for trading rather than investments. In these cases, cash flow is generated from receiving progress payments before construction is complete. This cash generated from selling a project reduces the need for additional debt. Further if the proceeds are more than the total amount of debt required, the cash is deposited into a reserve account. If there is money in this cash reserve account and future financing needs occur, then the reserve account is used for future cash needs. This cash process can be modeled in a similar way as the cash process that was described in a standard corporate model where deficit cash flow is funded by raising new debt and surplus cash goes to retiring cash and/or reducing debt.

Modelling a portfolio of different projects

In modeling a portfolio of projects, you would like to be able to change the occupancy dates, the construction dates and the S-curves of different parts of a portfolio. When programming different projects, reflecting different time periods can be accomplished by using the following general ideas:

First, establish a start date for the model. This start date is used to record the dates that are common to each of the projects in the model. If each column of the spreadsheet has the same date, then one can eventually add up all of the separate projects to obtain the aggregate cash flow for the calendar period. In the project finance models discussed above, the start date of the model and the start date of the construction (or development) are the same.

Second, develop a template model that can be used to compute the operating cash flow for each project. To make a template that works for each individual project, you can use the INDEX function along with a code number for each individual part of the portfolio. In the simple example presented below, the index command would be used to define the cost, the sale price, the construction profile and the period finished for the three components of the project. A single cash flow model would be set-up that uses the different cost, sales price and other inputs. If the inputs are set-up in a structured manner with items such as the completion date, the cost, the lease rate, the capitalization rate, the utilization rate and other factors, the amounts can be extracted for each separate project. In addition to the input data for individual projects, general assumptions should be made for factors such as the general inflation rate.

Assumptions								
		Code	Cost	Sales Price	Constr Profile	Period Finished		
Residential Type 1		1	1,000.00	1,500.00	3	1-Jan-12		
Residential Type 2		2	2,000.00	2,500.00	2	1-Jan-15		
Commecial		3	3,000.00	3,200.00	1	1-Jan-15		
Period		-5	-4	-3	-2	-1	0	Total
Profile 1	1	0%	0%	0%	25%	50%	25%	100%
Profile 2	2	0%	0%	0%	0%	50%	50%	100%
Profile 3	3	30%	25%	20%	10%	10%	5%	100%

Third, after the common start date is established, compute the period code. This is done through comparing the commercial operation date (called the temporary occupancy date in real estate) and the common start date. Using the inputs in the above example, the period code would be different for the first and the second project – it would be a larger negative number for the project with the further out date. This is analogous to computing the construction periods discussed above for the project finance model. Recall that if a periodic model is used, the DAYS360 function can be applied. (If the days in a 360 day are known and the model is computed on a monthly basis, then the DAYS360 command should be divided by 30.)

To see how this process works, assume that the common start date is 2012 and that there are two operating components. The first has a start date in 2014 and a two year construction period and the second has a start date of 2015. Both have a cost of 1,000 and a two year construction period. In this case the first period for the initial project is -1 and the first period for the second project is -2. The construction period is -1 and 0 for both projects. Since -1 is in the first year for the first project and it is the second year for the second project, the construction expenditures are arrayed differently. The manner in which the model for individual components can be set up is illustrated below. In the table below, the period code is used to define the S-curve table that defines construction expenditures as a function of the period code. The S-curve can is established by using an HLOOKUP table.

First Project													
Number	1												
Residential Type 1													
Commercial Date	1-Jan-12												
Periods Prior to Operation	5												
First Period	-4												
Profile Index+1	3												
Cost	1,000.00												
Price	1,500.00												
Period Code		-4	-3	-2	-1	0	1	2	3	4	5	6	7
Construction Profile		0.25	0.2	0.1	0.1	0.05	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Construction Profile		0.25	0.2	0.1	0.1	0.05	0	0	0	0	0	0	0
Cost		1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00
Construction		250.00	200.00	100.00	100.00	50.00	-	-	-	-	-	-	-
Cash Proceeds from Sales Price		-	-	-	-	-	1,500.00	-	-	-	-	-	-
Revenue Recognized - Pct of Completion		375.00	300.00	150.00	150.00	75.00	-	-	-	-	-	-	-

Once the individual cash flow model is established, the amounts from the individual parts should be aggregated in creating a financial model. The aggregation can be accomplished by using the data TABLE function. The code for the individual project is the column sensitivity in the data table and the column input is the number used in defining the INDEX function. In the above example, the column input is the cell reference for the number 1. Simply add the cash flows for different projects using a date code that begins with the overall model start date that was used to compute the period code for each project. The manner in which the data table can be used to aggregate cash flows from individual projects is illustrated in the table below.

Cash Flow Analysis											
Total Proceeds from Sales											
Residential Type 1	-	-	-	-	-	1,500.00	-	-	-	-	-
1 Residential Type 1	-	-	-	-	-	1,500.00	-	-	-	-	-
2 Residential Type 2	-	-	-	-	-	-	-	2,500.00	-	-	-
3 Commecial	-	-	-	-	-	-	-	-	-	-	3,200.00
Construction Expenditures											
Residential Type 1	-	-	250.00	500.00	250.00	-	-	-	-	-	-
1 Residential Type 1	-	-	250.00	500.00	250.00	-	-	-	-	-	-
2 Residential Type 2	-	-	-	-	500.00	1,000.00	500.00	-	-	-	-
3 Commecial	-	-	-	-	-	-	-	750.00	1,500.00	750.00	-
Net Cash Flow											
1 Residential Type 1		-	(250.00)	(500.00)	(250.00)	1,500.00	-	-	-	-	-
2 Residential Type 2		-	-	-	(500.00)	(1,000.00)	(500.00)	2,500.00	-	-	-
3 Commecial		-	-	-	-	-	-	(750.00)	(1,500.00)	(750.00)	3,200.00

Once the cash flows are aggregated, the financial model can be developed. Since there are multiple parts with different construction and cash flows, the model should not necessarily begin with a sources and uses statement. Instead, a working capital facility and a debt facility can be developed for situations when the cash flow is negative. Similarly, a routine can be developed to issue equity before or after the issuance of debt. Methods to develop the debt schedule and a cash flow statement with a waterfall involving structuring the cash flow statement and using the MIN and MAX functions is described above.

The general idea of establishing the size of debt and the debt capacity is an important issue in risk analysis and cost of capital (chapter 4). In determining the amount of debt that can be supported by a company or a project, one cannot generally boil the analysis down to a simple formula such as setting the debt service coverage ratio to 1.6 in order to obtain a BBB bond rating. Once the process of setting some financial ratio to a benchmark level has been established, the mechanical process depends on how the level of debt is computed in a model. A simple approach is to compute the debt level from a given leverage ratio through multiplying the total uses of funds by the ratio. This method can lead to circularity problems because the amount of the fees and the interest during construction drive the uses of funds. This method does not conform to reality and it does not allow computation of items such as commitment fees, up-front fees and required funding of cost over-runs.